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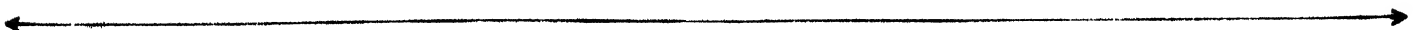
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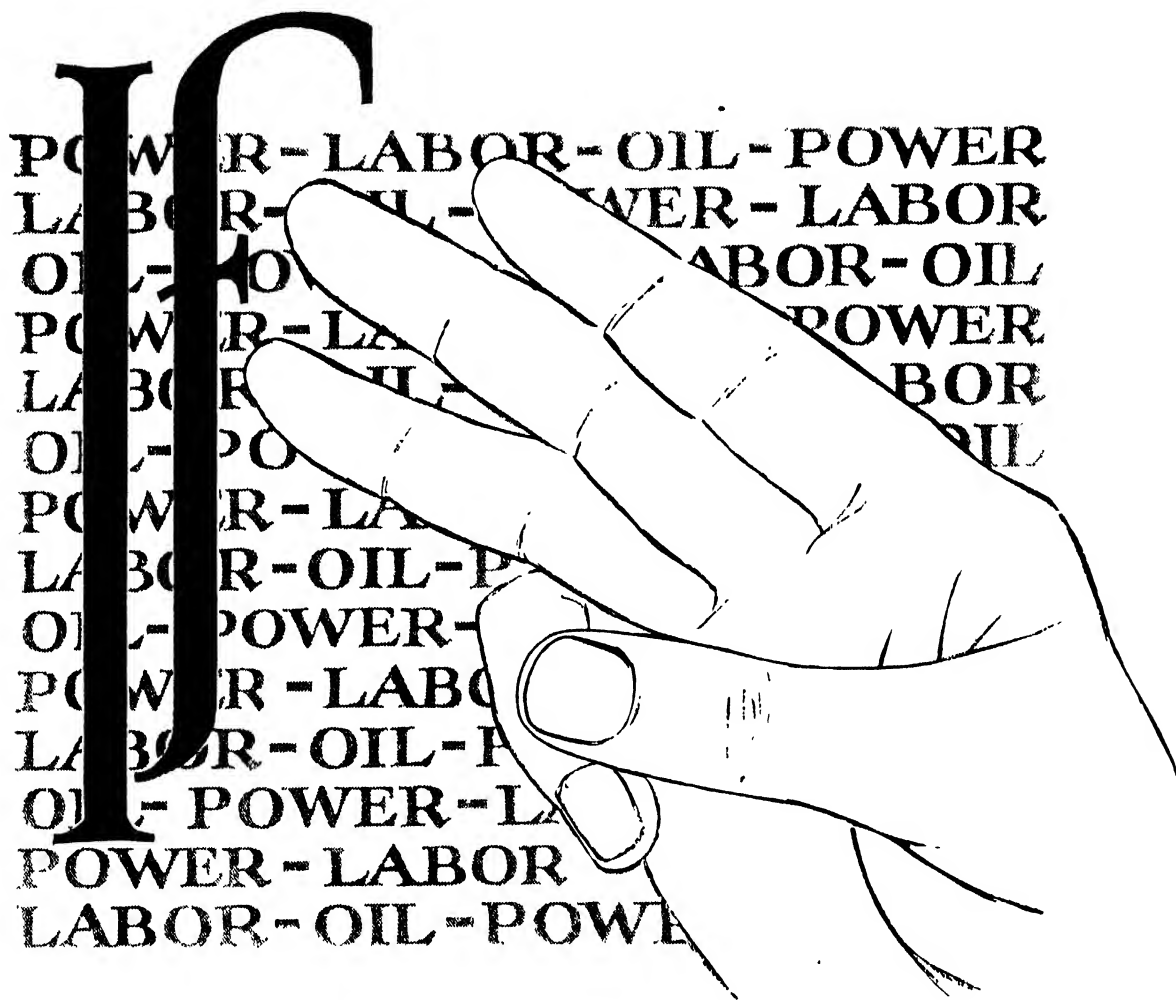
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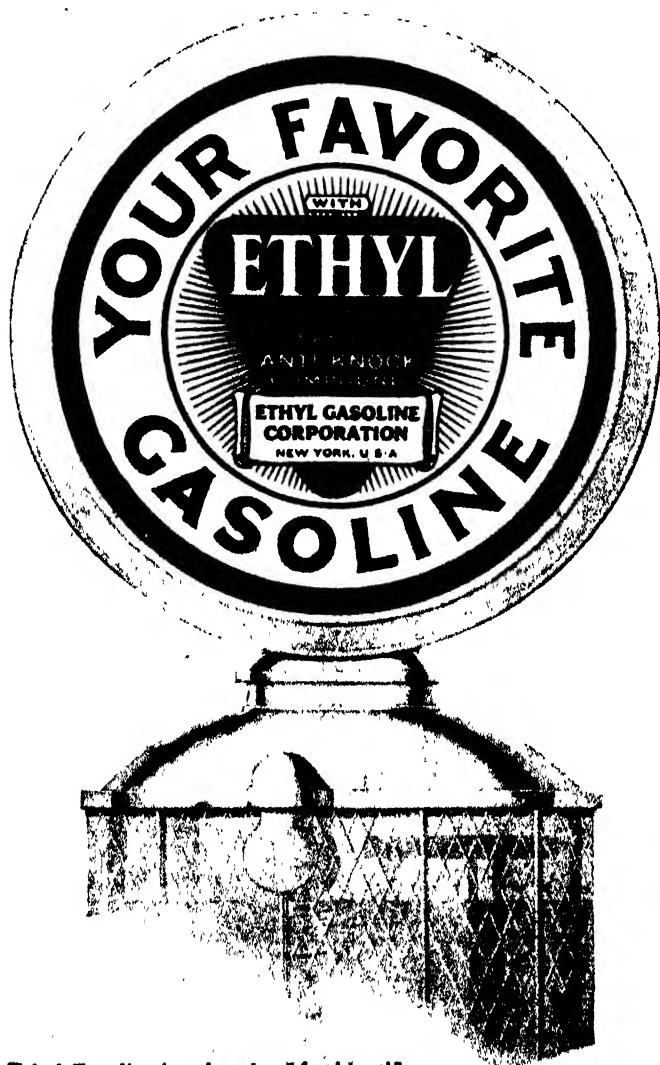
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SCIENTIFIC AMERICAN

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Eighty-fourth Year

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COVER

Our artist, Howard V. Brown, has vividly portrayed a cultivated field of the rubber-producing shrub, guayule. Turn to page 16 for the story.

Creating Car Life

Timken Bearing steel is produced in Timken electric furnaces and processed in the Timken mill to become the most wear-resistant bearing material ever known.

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MAKE	MODEL	Front Wheels	Rear Wheels	Pinion	Steering Differ- ential
Auburn	All	x	x	x	x
Cadillac	All	x	x	x	x
Chandler	Special 6	x	x	x	x
Chrysler	Big 6 & Royal 8	x	x	x	x
	52-62-72	x	x	x	x
	80	x	x	x	x
Cunningham	All	x	x	x	x
Dodge	All	x	x	x	x
Durant	55	x	x	x	x
	65 & 75	x	x	x	x
	6-70	x	x	x	x
Elcar	8-78, 8-82	x	x	x	x
	8-91, 8-92	x	x	x	x
Falcon	All	x	x	x	x
Ford	All	x	x	x	x
Franklin	All	x	x	x	x
Gardner	All	x	x	x	x
Graham-Paige	610	x	x	x	x
	614	x	x	x	x
	619, 629, 835	x	x	x	x
Hudson and Essex	All	x	x	x	x
Hupmobile	6	x	x	x	x
	Big 8	x	x	x	x
	Century 8	x	x	x	x
Jordan	All	x	x	x	x
Kissel	All	x	x	x	x
LaSalle	All	x	x	x	x
Lincoln	All	x	x	x	x
Locomobile	8-70	x	x	x	x
Marmon	68	x	x	x	x
	78	x	x	x	x
McFarlan	All	x	x	x	x
Moon	All	x	x	x	x
Nash	Std 6	x	x	x	x
	6 and 8	x	x	x	x
	8-69	x	x	x	x
Peerless	6-91, 6-60	x	x	x	x
	and 6-80	x	x	x	x
Pierce-Arrow	81	x	x	x	x
	36	x	x	x	x
Reo	Flying Cloud	x	x	x	x
	Wolverine	x	x	x	x
Star	All	x	x	x	x
Stearns-Knight	All	x	x	x	x
Studebaker	All	x	x	x	x
and Erskine	All	x	x	x	x
Stutz	All	x	x	x	x
Vellie	All	x	x	x	x
Willys-Overland	Whippet 4	x	x	x	x
	Whippet 6	x	x	x	x
	50	x	x	x	x
	66-A	x	x	x	x
	70-A	x	x	x	x

Looking Ahead With the Editor

Aristotle Dethroned

WHEN Galileo, working for 15 cents a day as professor of mathematics at the University of Pisa, contended that heavy and light bodies fall at the same rate, the idea was hooted. Aristotle, preceptor of the age, had said otherwise. But Galileo persisted, proved his contention, and learned many other scientific truths. The outline of the progress of physics since then, to be published soon, makes a story as interesting as fiction.

A Huge Hydro-electric Development

IN an article to appear soon, a comprehensive description will be given of the new hydro-electric plant on the Susquehanna River in Maryland. Its machinery for producing 378,000 horsepower represents the largest units ever installed in a single plant at one time. Several other features, some of which are the largest in the world, make this plant well worth study by practicing engineers as well as students of engineering.

The Museum Proves This Fish Story

ZANE GREY is not an ichthyologist; he is an angler of no little fame. But the catches he and his party have made in New Zealand waters are of interest to both the angler and the scientist. Mr. Grey is, first of all, a sportsman, but many specimens subdued by him with rod and line, are now on exhibition in the American Museum of Natural History. His article about his remarkable catches is ready for release.

Taking the Next "Ship" to Mars

ANOTHER romance? Jules Verne or H. G. Wells? Neither; the article which we shall present at an early date, concerns a physicist's concept of a method for making a trip from the Earth to Mars. Laymen who read the manuscript scoffed, but several scientists pronounced this interplanetary flight practicable. The "ship" is not a projectile, but a rocket, the details of which have been worked out scientifically. Coming soon.

Chromium Plating

SO great has been the interest in the process of chromium plating of metals during recent months that we have arranged to give you an article about it. Bunsen first obtained metallic chromium 75 years ago but its introduction as a commercial plating metal is of comparatively recent date. Even now, although many common products are chromium plated—especially where extreme hardness of surface is desirable—the process is a difficult one requiring much study.

Every Issue Fully Illustrated

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Among our Contributors

D. T. MacDougal



Dr. MacDougal, one of our corresponding editors, is a plant physiologist who enjoys digging to the bottom of things. Out in the desert regions of Arizona, he puts trees through all sorts of measurements to ascertain, not merely how they grow, but why. He injects chemicals into cacti and watches the circulation of the sap. Incidentally, he keeps one eye on desert rubber, for his life work has been devoted to adapting desert plants to domestic life and adapting domestic plants to desert climates.

Paul R. Heyl

By now our readers are quite familiar with Dr. Heyl's writing. At the United States Bureau of Standards he is usually concentrated on some problem indirectly vital to the world. He has something of a reputation as a popularizer of science; few scientists so ably understand and explain difficulties that perplex the beginner.

Harold J. Cook

A university-trained geologist, Mr. Cook has two strings to his bow: he earns his living as a petroleum geologist, and makes fossil hunting his avocation. His bailiwick is the entire west. Some of the investigations of geological discoveries which he has made for the editors, give promise of "proving up" in evidence most precious to science.

Charles P. Olivier

Professor Olivier is an authority on meteors, his book entitled "Meteors" being the last word on that subject. He heads the American Meteor Society, which you may easily join. Next September he will assume the directorship of the Flower Observatory of the University of Pennsylvania, located in the suburbs of Philadelphia.

Henry Norris Russell

Professor Russell, another of our corresponding editors, has been a contributor for 27 years, during which time he has sent us regularly a monthly article on astronomy. His astronomical researches have won for him no less than four scientific medals. He is a member of many scientific societies, Chairman of the Department of Astronomy of Princeton University, and is a Research Associate of Mount Wilson Observatory.

Abrasives in Industrial Progress



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Edward W. Berry

PROFESSOR EDWARD W. BERRY of Johns Hopkins University, whose article, "How Old Are the Everlasting Hills," starts on page 31, specializes in that particular corner of the science of paleontology known as paleobotany, the study of the evolution of plant life by means of the fossil evidences of the rocks, although his university work deals mostly with the animal side of the subject. There are few paleontologists and far fewer paleobotanists—a mere handful, in fact, of these super-specialists. Professor Berry has had an unusual career, for a scientist; he began as a

business man and newspaper man, having been president and manager of the *Passaic* (New Jersey) *News* during eight years. However, he had leaned toward science even as a boy, having collected, according to local tradition, nearly all the fossils in Schoharie County, New York, his home county, before he was 18 years of age. After departing from newspaper work he won his way to full professorship in paleontology at Johns Hopkins, where it is frequently said by his students that he is a great teacher because he "makes them think." Here he is shown in his laboratory.

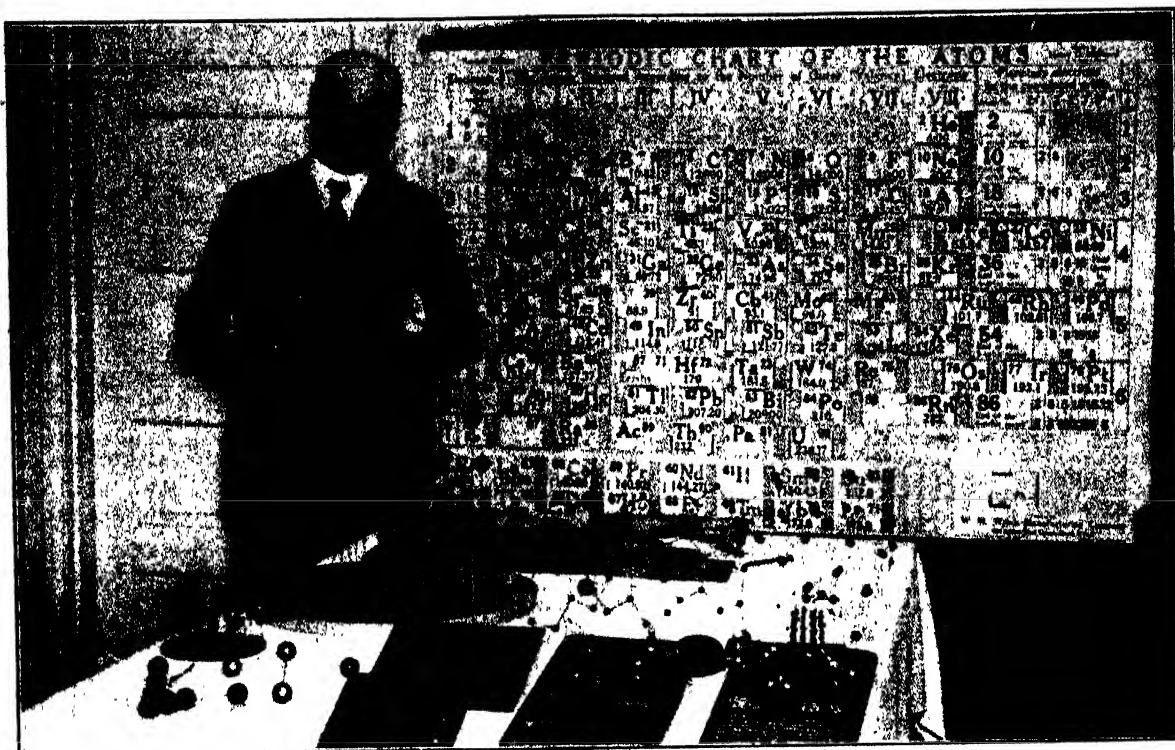


M-G-M News

Captain George H. Wilkins

CAPTAIN WILKINS (who wears the cap; the other is his pilot, Lieutenant Eielson) literally leaped to world fame when he recently flew across the top of the world from Alaska to Spitsbergen in 21 hours. Captain Wilkins is an Australian. Back of this epochal flight is a long period of service and training in exploration, first as second-in-command under the explorer Stefansson in the arctic; then as second-in-command with the British Imperial Antarctic Expedition

of 1920-21; later as naturalist with Shackleton in 1921-22; and in 1923-25 as leader of an expedition for the British Museum. His recent flight, together with evidence provided by some previous deep soundings he made in the arctic, practically destroys the force of the old Harris theory of a large arctic land mass and reinforces the Nansen theory that the arctic is a great, deep ocean basin, similar in this characteristic to those of the other great oceans of the world.



Harrie and Ewing

MODELS OF MOLECULES AND ATOMS, AND THE PERIODIC TABLE

Mr. Hubbard of the Bureau of Standards holding in his right hand a model of the tetrahedral carbon atom. In front of him is the diamond molecule with its "interlocked" atoms of carbon the real reason for the hardness of diamonds

What Is An Atom?*

The Newest Concept of the Atom Is Known as the "Schrödinger" Atom. What Is Its Fundamental Nature?

By PAUL R. HEYL, Ph.D.
Physicist, United States Bureau of Standards

"I WANT to see an atom!" announced the visitor.

"So do I!" replied the scientist to whose office the visitor had come.

"But can't you show me one?" pursued the visitor. "I thought the Bureau of Standards had the best of everything in the way of equipment—microscopes and all."

The scientist shook his head.

"The best is not good enough for that. No one has ever seen an atom; none of us here hopes ever to see one. It is like the famous purple cow."

"Is that the case?" asked the visitor, disappointedly.

"Yes. Their size is one reason why we cannot see them. It is a good microscope that will clearly define an object one hundred-thousandth of an inch in diameter; yet into a cube of this size one might easily pack a hundred million atoms. And even if we had a sufficiently powerful microscope the atoms would not stand still long enough

for us to see what they look like."

"But then how have you found out all that you know about them?"

"We know very little about them—not nearly as much as is commonly supposed. We do know their size roughly, within certain limits, and we know pretty well how they behave under all sorts of conditions; for the behavior of atoms (and molecules) under different conditions is all that physical or chemical experiment can tell us; but as to what an atom looks like, we know nothing at all."

"BUT, pardon me," said the visitor, "does not an atom resemble a miniature solar system?"

"That was Bohr's idea of its appearance, and a most useful and valuable concept it has been."

"So the Bohr atom is a 'has been'?"

The scientist smiled.

"It never was entirely satisfactory, even to the inventor himself. It was accepted provisionally—in fact, we may say tolerated for lack of a better."

"That is strange," mused the visitor.

"I never thought that the Bohr atom had any faults that is, any serious ones. I supposed from the way it was talked and written about that it was all right—a real scientific discovery."

"The Bohr atom had many good points. It was far and away ahead of anything that had ever been devised before, but it so happened that its good points were of such a nature as to lend themselves readily to popular exposition, while its shortcomings were of a more difficult and technical character."

"But," urged the visitor, "the Bohr atom is so in harmony with that part of the structure of Nature which is large enough for us to see—just like our planetary system. Is it not likely that the architecture of Nature is one from electron to star? I can hardly believe that it is not so. It is so beautiful that it must be true!"

The scientist smiled again, perhaps a little sadly.

"If we could see the real plan of an atom, absolutely free from blemishes as it must be, it would be so true that nothing could be more beautiful."

*Publication approved by the Director of the Bureau of Standards of the U. S. Department of Commerce.

The visitor was silent for a few minutes. Then he said slowly:

"There is something I do not understand. In speaking about the Bohr atom you have used the words 'Bohr's idea,' 'inventor' and 'devised.' Was it not a discovery?"

"No, I have used the plain English for it. The story of the Bohr atom is no departure from the history of all our past ideas about atoms. We learn by experiment that an atom will do certain things. We then exercise our inventiveness and ingenuity in imagining a model of an atom that will do

particles of such sizes and figures, and with such other properties and in such proportion to space as most conduces to the end for which he formed them; and that these primitive particles being solids are incomparably harder than any porous bodies compounded of them; even so very hard as never to wear or break in pieces; no ordinary power being able to divide what God made one in the first creation."

"You will notice one important point," said the scientist, laying down the book. "Newton imagined the atoms as infinitely hard, and explained

tex ring in the ether which carried light waves through space."

"And what happened to this model? The usual thing?"

The scientist nodded.

"The same old story that had been told so often in the two centuries between Newton and Kelvin. The vortex atom fulfilled quite a number of the requirements, which were rather numerous, even fifty years ago. It could vibrate from a circular to an elliptical shape and back again, and in so doing send out ripples in the surrounding ether—that is, light waves. But one thing it could not be made to do, nor could any model that had preceded it. They absolutely refused to attract each other. This sealed the fate of the vortex atom."

"What took its place?"

"Nothing—for a generation. In the closing years of the nineteenth century the late Professor Rowland of Johns Hopkins University, impressed by the number of lines in the spectrum of iron, said: 'I do not know what an atom of iron may be, but it must be as complicated a structure as a grand piano.'"

"THE Bohr atom is much simpler than that."

"Yes, but we must remember that Rowland did not live to see the beginning of the great development in physical science that followed the discovery of the X rays. As a result of the new knowledge this has brought us we have learned one important thing about the atom: it must be electrical in its structure."

"That is a long way from Newton's grains of flint," said the visitor.

"Yes, indeed. Since we have as yet no idea of what electricity may be, an atom built of it is rather a transcendental affair."

"This is all very interesting," said the visitor. "Almost as good as seeing an atom. I can see now why Bohr built up his model from electric charges—electrons and protons, I believe they are called. But would the Bohr atom gravitate?"

The scientist laughed.

"It didn't have to."

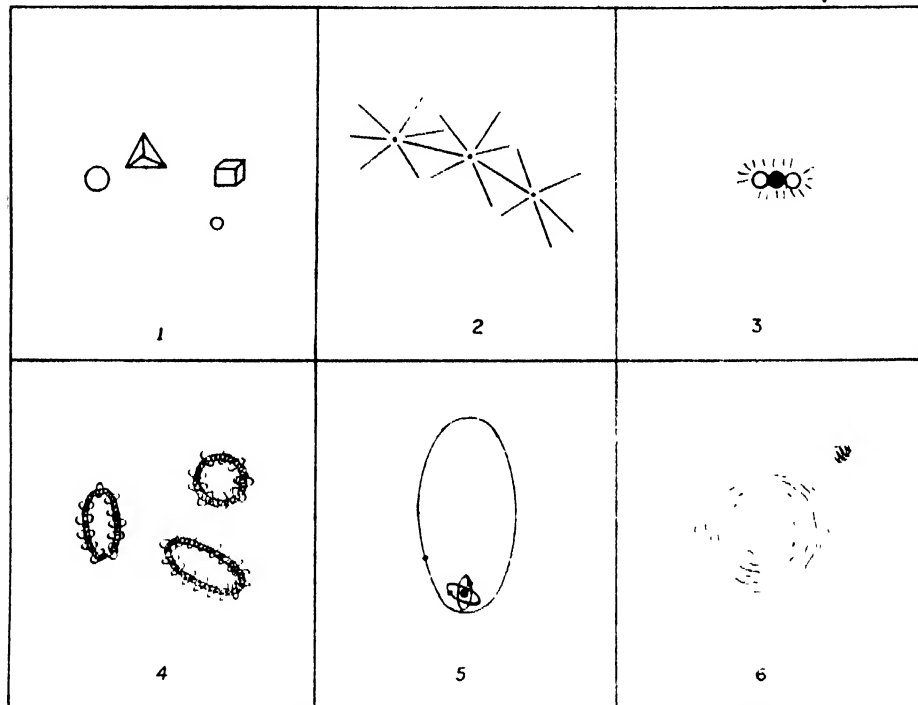
"Didn't have to? After the vortex atom and all the rest had gone into the discard for that very reason? What had happened in the meantime?"

"Einstein."

The visitor threw up his hands and shook his head.

"I'll take your word for it," said he. "What is it?"

"Prior to Einstein," explained the scientist, "gravitation was regarded as a property of matter. Einstein pointed out that it might be a property of space. According to this, matter gravitates not because of any peculiarity in its structure but because of the properties of the space that surrounds it. Any kind of an atom is as good as any



THE EVOLUTION OF MAN'S CONCEPT OF THE ATOM

1. Newton's concept (1704)—hard particles; various shapes. 2. "Centers of force" or mathematical points of Bosovich (1758). 3. Dalton's particles having definite weights (1810). 4. Kelvin (1867) vortex ring atom. 5: Bohr's lithium atom (1913). 6: Schrodinger's atom (1925)

these things. Then we experiment further and learn some new things that an atom can do. If our model is capable of performing these tricks also, well and good; but it always happens sooner or later that our model breaks down under some task imposed upon it by new discoveries. Then we must either alter it or abandon it and devise a new one."

"Who invented the first model of the atom, and what was it?"

"THE ancients guessed that there might be such things, but they had next to no experimental results to control their guesses, and in consequence their fancy had free play. The first model of an atom that properly belongs in the modern scientific period is that of Newton. Here is what he said about it in his 'Opticks.' And the scientist took down a book from a shelf behind him.

"It seems probable to me that God in the beginning formed matter in solid, massy, hard, impenetrable, movable

the softness of bodies by saying that it was due in some way to the arrangement and mutual action of their hard constituent particles. Two hundred years later Lord Kelvin completely reversed this mental attitude, and taught us to look for the explanation of the hardness of bodies in the rapid motion of something infinitely soft and yielding."

"Yes," said the visitor, whose hair was gray. "I think I remember hearing about that when I was in college. He thought an atom was something like a smoke ring, didn't he?"

"Yes, a vortex atom, he called it. He adduced several familiar facts in support of this new view point. The stream of water from the nozzle of a fire hose will turn aside the blow of an axe; and the rag wheel used in burnishing is, when at rest, as loose and floppy a structure as one can well imagine, but when set rapidly spinning it becomes so stiff that it takes considerable force to bend it. Lord Kelvin's idea was that an atom might be a spinning vor-

other from this new point of view."

"Then why not reconsider some of the earlier models?"

"No, we have discovered so much that is new about atomic behavior that the older models are hopelessly inadequate and out of the running."

"Just as the Bohr atom is, if I understand you correctly. But what is the exact trouble with it?"

"Something which was recognized from the very start, and was pointed out by Bohr himself. Simple and natural as the Bohr atom may appear, there is a serious indictment to be brought against it: it is not self-consistent. In order to make his atom work, Bohr found it necessary to play fast and loose with established electrical principles, discarding them where advisable and retaining them where convenient without any excuse other than necessity."

FOR example, a charged particle such as an electron should radiate energy when revolving in a circle. Bohr said that it should not, but in the next breath admitted that it should radiate while changing from one orbit to another. No one was readier to admit this inconsistency than Bohr himself. His justification for it was that it worked well, and it certainly did. The success of the Bohr atom in accounting for chemical and physical facts has been almost uncanny. Upon the basis of these untenable assumptions Bohr and his fellow workers erected a statue marvelously true to Nature, yet this statue had feet of clay. We tolerated it for lack of a better, knowing that it was doomed to fall as soon as a more logical and consistent substitute should make its appearance."

"And has something else made its

"I haven't heard of that," said the visitor.

"No," said the scientist. "It is only three years old, and many of us professionals are still rather hazy in our understanding of it."

"Of course it must be electrical, from what you have said."

"Yes, certainly; that feature appears to be definitely fixed in all atomic models. The difference between the Schrödinger atom and the Bohr atom is, to begin with, one of distribution of the electricity. In the Bohr atom, as you know, there was a positive charge on the central nucleus, and negative charges on each planet or electron. The electric charge was localized in spots. But in Schrödinger's atom the charge is spread everywhere throughout the volume of a little sphere of atomic dimensions. Again, the electrons in Bohr's atom were in rapid motion in their orbits, while in the Schrödinger atom the electric charge does not move about. It does, however, change its intensity at different points in the sphere at different instants of time. This fluctuation in the strength of the electric charge sets up light waves in the surrounding space."

THE Bohr atom, as I recollect it," said the visitor, "was in the habit of throwing off one of its electrons occasionally. I used to picture

quivering ball of electric charge throws off a small portion of itself, a little bunch of vibrating energy, which represents the electron. Perhaps later on this little bunch of energy strikes another



EVIDENCE THAT ATOMS ARE ELECTRICAL

The spectrum of an element may be altered by an intense magnetic field—the "Zeeman effect." Dr. W. F. Meggers of the Bureau of Standards, standing beside the magnets employed

atom somewhere else, and coalesces with it, adding its energy to the larger quivering mass. You have seen tufts of isolated flame rising from a wood fire; except for the fact that they do not last more than half a second or so, they represent pretty well Schrödinger's idea of the emission of an electron from an atom."

"There doesn't seem to be much complicated mechanism in that," said the visitor, thoughtfully. "I wonder what Rowland would have said of it."

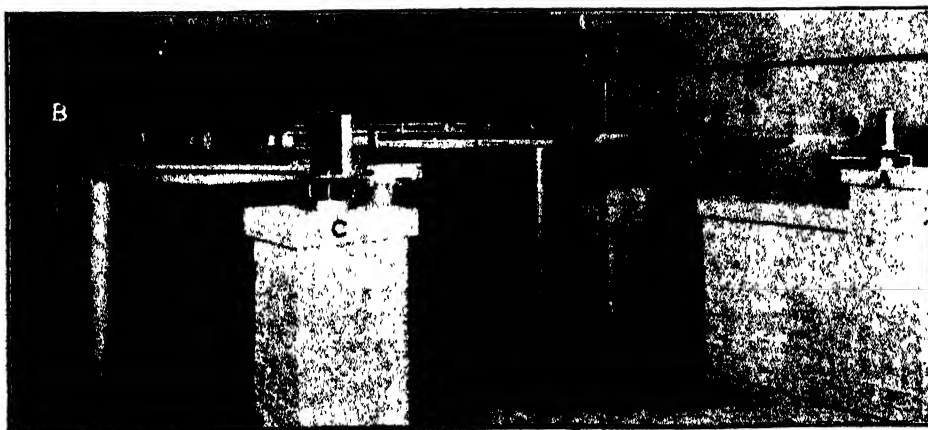
"True," said the scientist. "Our atomic models in their general aspect do seem to be getting simpler, but their mathematical theory makes up for that. To follow up the behavior to be expected of a quivering ball of electric charge such as the Schrödinger atom requires mathematical equipment of no mean order."

SUPPOSE it done," said the visitor. "What will the Schrödinger atom do?"

"Everything that the Bohr atom could do, and a little more; and the best thing about it is that it works without doing violence to established electrical principles as did Bohr's atom."

"Yet I suppose you will eventually find something the matter with it?"

"Surely; we are a long way from perfection yet. This is a very new scientific baby—only three years old. No one can tell what bad habits it will exhibit when it is a little older, or how it will stand up under the requirements of new discoveries which are certain to be made. Even now it looks as if such an atom could not exist alone;



CONCAVE GRATING SPECTROSCOPE AT BUREAU OF STANDARDS

The grating A, throws a spectrum on a photographic plate at B; this may be placed anywhere on the circular rack. C is a reflecting mirror which sends light to the grating

appearance, or are we still without any mental picture of an atom?"

"Something else has made its appearance, but I would hardly say that we can get as good a mental picture of it as we had of the Bohr atom. It is the wave atom of Schrödinger."

that as drops of water being thrown off from a rapidly revolving grindstone."

"Yes," said the scientist. "Every atomic model must be able to do that. Experimental evidence demands it. Schrödinger pictures it in this way: his

that it must be one of many such, equally spaced like soldiers in open order. But whatever may be its ultimate fate, it is for the present a step in advance."

"No," said the scientist. "That question did not suggest itself to the mind of the man who first saw what you are seeing, for this discovery happened before the days of machinery. This is

jostling these visible specks, which, although much more massive than the molecules that hit them, are yet perceptibly shaken by the impact. I cannot show you an atom; I cannot even show you a molecule; but you have seen the results of the impact of a molecule.

"And speaking of impacts," continued the scientist, "I see you are wearing a luminous watch on your wrist. Here is a rather strong magnifying glass; when I turn out the light, examine one of the bright spots on the dial."

As the light went out the visitor uttered an exclamation, and started to speak, but suddenly checked himself. After a minute's observation he said slowly:

"I think these really twinkle. I was just about to say that this looked exactly like the spots of light in the little drop of water under the microscope."

"Exactly," said the scientist. "What appears to the unaided eye as a uniform glow you now see to be made up of myriads of tiny flashes of light, appearing for an instant, and then dying out."

"What causes them?"

"Each flash is caused by the impact of a particle shot out from a radium atom in the paint. The bulk of the paint is a special kind of sulfide of zinc. When one of these little bullets strikes a crystal of this compound there is a tiny flash of light. You are watching the disintegration of radium, atom by atom."

"Well," said the visitor as the light was turned on, "this has been almost as good as seeing an atom. I have had a crowded hour!"

"If we could only see an atom," said the visitor, "we could take all the remaining steps at once."

"That we cannot do at present," said the scientist. "But come with me," he added, rising, "and I'll show you the nearest thing to an atom that it is possible for us now to see."

He led the way out of his office to a small dark room opening out of the laboratory, and turned on a switch. The room as a whole remained dimly lighted, but the visitor saw a microscope with an intensely illuminated object on its stage.

"Look," said the scientist.

The visitor put his eye to the microscope. Against a dark background he saw a multitude of star-like points of light.

"Twinkle, twinkle little star!" he said.

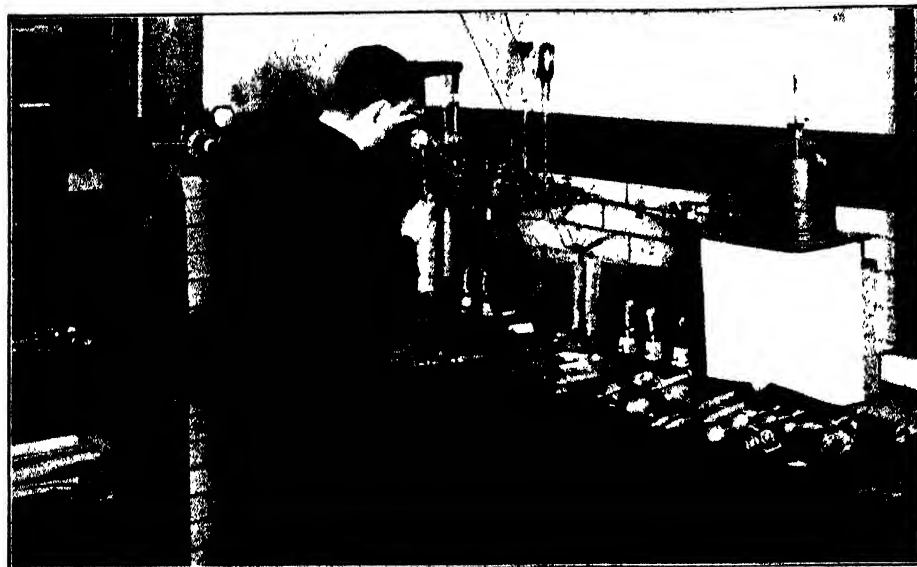
"No," said the scientist. "You have spoken too quickly. Watch for a minute."

"WHY, of course!" said the visitor. "They are not twinkling; their brightness remains the same. They are only quivering and trembling. What are they?"

"Under the lens of the microscope," said the scientist, "there is a drop of liquid with extremely fine particles of solid matter suspended in it, just enough to give the liquid an opalescent appearance. The points which you see are these tiny little particles illuminated by the beam of light focussed upon them."

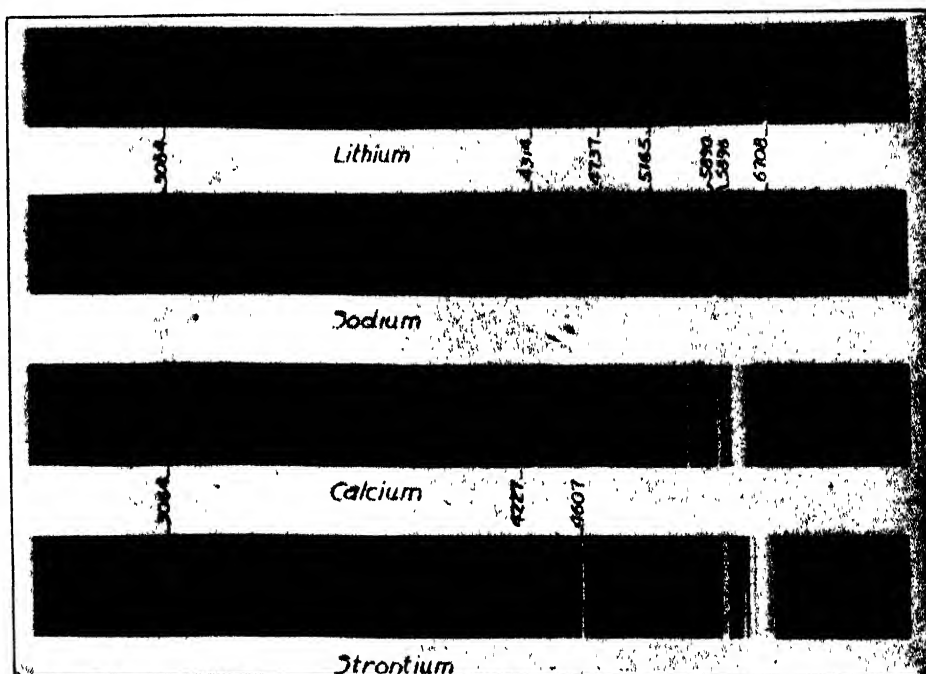
"But what keeps them in constant motion? I do not feel any vibration of machinery through the floor."

called the Brownian motion. The illuminated particles are being continually battered about in all directions by the impact of the liquid molecules surrounding them. These particles are the smallest things we can see under the microscope, but they are many times larger than a water molecule, and a molecule, being a conglomerate of atoms, is in turn much larger than an atom. But the water molecules are in rapid motion, milling about among one another like people in a loosely packed crowd. They are continually



PREPARING VACUUM TUBES FOR USE IN THE SPECTROSCOPE

Much of our knowledge about atoms comes through the spectroscope which reveals their secrets not only in the laboratory of the physicist but in distant parts of the universe



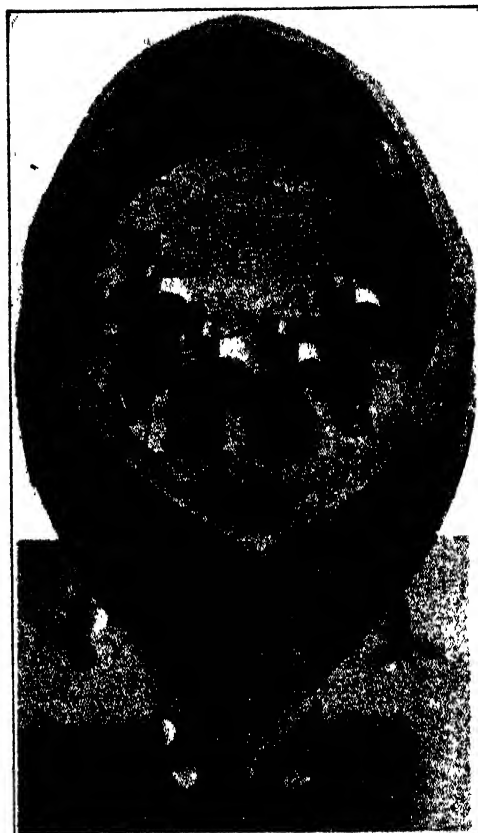
SPECTRUM PHOTOGRAPHS OF LIGHT EMITTED BY FOUR ELEMENTS

These are bright line spectra of the type obtainable from gases and vapors when made incandescent by electric discharge. Each wavelength emitted gives a bright line in the spectrum

Towing Tests Solve Ship-power Problems

MORE than 2800 ships of the United States Navy, our Shipping Board, and of commercial fleets have been remarkably successful in operation because, before they were built, they were tested carefully in model form. At the Washington Navy Yard, a huge indoor pool for testing exact models of future ships is maintained, together with a staff of expert ship-model builders and testers. The behavior of the models under test conditions shows up errors in design of hull or balance, gives an exact indication of steam-power requirements, and solves many important problems for the designer. The enclosed concrete testing pool is 470 feet long, 42 feet

wide, 14 feet deep in the center, and holds 1,000,000 gallons of water. Wave conditions, to imitate stormy seas, are produced by a hinged bulkhead at one end of the basin which swings to and fro under electrical control. The towing table consists of a 40-ton traveling crane that spans the pool. It is equipped with electrical motors that operate it at speeds ranging from one half knot to 15 knots an hour. The ship models are usually 20 feet long, some of them being towed by the crane while others are tested while operating on their own power. These latter models are equipped with small electric motors which drive the small propellers.



SELF-PROPELLED ➤

The power required by each motor and propeller on this model, is recorded on the paper rolls



ROUGH SHAPING

This special machine was originated at the Washington Navy Yard. It cuts and shapes any design of model hull



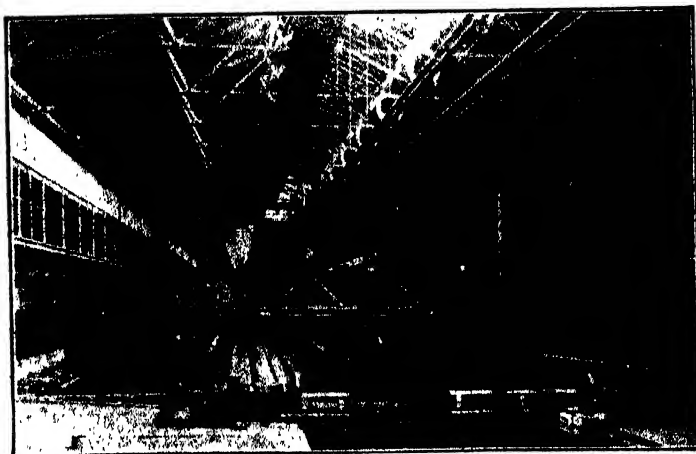
HAND-FINISHING THE BOTTOM

After rough machine work, all models are finished by hand. Redwood is used for most model hulls because it is satisfactory and cheap



BARGE-MODEL TEST

River barges are tested by towing with the crane, a good view of which is shown here. The crane is provided with a wide working platform



WAVE-MAKERS

In the foreground may be seen the mechanism that operates the wave-making bulkhead. Towing carriage, or crane, stands near end of pool

Our Point

STOP THAT NOISE!

A GROWING recognition of the right of the citizen to be protected against offenses to his senses of sight, smell, and hearing will mark the future of city administration. Already we have provisions designed to secure for the individual his proper share of light and air. Similarly we shall begin to recognize his right to protest against ugly surroundings in the shape of hideous architectural and engineering structures, and the plastering of buildings with advertisements until some sections of a city become an abomination.

But we think the most serious trespass against the comfort of the dwellers in cities, and especially in those of great size, is in the matter of noise; and for ear-splitting, nerve-shattering din, we know of nothing, not even the roar of an elevated railway, to compare with the racket of the riveting hammer.

We make no complaint against the pneumatic riveter as such; for it is one of the most ingenious and efficient of the many tools which have contributed to the great architectural and engineering achievements of the present age. Huge ocean liners, big bridges, and the towering office buildings of today are greatly indebted for their rapid and economical construction to the pneumatic riveter. But the time has come when the infernal racket of the machines should be prohibited on buildings that are being erected in districts which are already crowded with office or residential buildings. A substitute for the pneumatic riveter is available in electric welding which "has proved preferable to riveting where," as in the present case, "it offers some inherent advantage."

As we have recorded from time to time in these columns, electric welding has given satisfaction in full-size tests, carried out in shipbuilding, in machine shop work, and, above all, in the erection of a steel building—this last job having been done under strict engineering supervision, with a close accounting as to cost.

With such facts behind them, our municipal authorities will be justified in saying to the building contractor: "Stop that noise!"

AIRPORT IMPORTANCE

COLONEL LINDBERGH'S praiseworthy endeavor to make Congress "air-minded," successfully completed a short time ago, marks another important step in the progress of

aviation in this country. With his splendid aid, and that of other veterans of the air, it will be only a matter of time until every city of any size in this

Floyd Bennett

MEN, hardened of face, bored, blase, or burdened with a thousand cares, were seen to pause recently on Fifth Avenue, New York; cast a questioning glance up and down the street; and then, seemingly, a catch came into their throats; they gulped and their faces softened. The cause? Bunting and decorations fluttered gaily in the breeze—for the crew of the *Bremen* would soon arrive—but the flags of three nations that fluttered over the sidewalks from hundreds of buildings were at half mast. Valiant Floyd Bennett had died.

Bennett had "died in harness." An air victor himself, he wished, despite low health, to be the first to welcome to America and to aid three other victors. Thus did he wing his way toward lonely Greenly Island, contract fatal pneumonia, and die no less a hero than if he had crashed while on some momentous pioneering flight. He died as he had lived, a true gentleman and a courageous, a man whose life was devoted to the cause of aviation, one whose loyalty to his kind stood high within him.

To Bennett's memory the United States has paid homage by according him the honors of a naval hero dead "in line of service" and by interring his body near that of Peary. Peary was the first to reach the North Pole and Bennett was the first to pilot a machine of the air—Commander Byrd's *Josephine Ford*—over that same expanse of ice. The nation and the whole world mourns an irreparable loss. What more fitting, then, that Commander Byrd, whose second in command Bennett was, should render further tribute to his memory by naming his expedition The Floyd Bennett Antarctic Expedition and christening his chief airplane the *Floyd Bennett*!

country will have its municipal airport. In fact, with the ever-increasing net-work of air-mail and air-transport lines, cities without well-ordered landing fields may soon find themselves hopelessly out of date.

But no matter how great or how

urgent may be the need of such a field, the construction of it should come only after careful thought and close study of the conditions to be met. The National Municipal League, 261 Broadway, New York, has recently published a supplement to its *Review*, entitled *Airports As a Factor In City Planning*, which should prove of great assistance to cities interested in airports. It discusses accessibility, area requirements, factors influencing area, site selection, future development, and costs; and contains diagrams of suggested layouts of efficient fields. Officials of cities contemplating the construction of airports will do well to obtain this supplement and study it carefully. Although not an exhaustive treatise of the subject, it will nevertheless settle many questions at once, while it inspires constructive thought on those problems most necessary of consideration.

DANGEROUS ENTHUSIASM

ALTHOUGH various methods of transmitting and receiving images of moving objects by radio (television) have been described at length in this and other publications, there is one point that must be stressed strongly. Be wary indeed of any smooth-tongued salesman who attempts to inveigle you into investing in a television promotion scheme.

While there are several reliable companies assiduously bent on developing worthwhile methods of television, there are (and there will be more) companies not so reliable who are more interested in moving the contents of your pocketbook than they are in moving pictures by radio. Any scheme for television development should be thoroughly investigated before investing. And the investigation should include not only the members of the company, but the television system as well. The services of someone well versed in radio will be needed here, but the end will be worth the trouble.

RAILROADS SHOULD STUDY AIR RESISTANCE

WHEN *Railway Age* tells us that "atmospheric resistance absorbs something like one half of the power of a train going 60 miles per hour and over," it is time for railroad management to sit up and take notice. The total resistance of a train is made up of the internal frictional resistance of the bearings, the rolling resistance between the wheels and the track, and

of View

the atmospheric resistance due to the thrusting aside or displacement of the air by the onrushing train. The first has been greatly reduced by the use of roller bearings; the second by accurately turned wheels, heavy rails, and careful track maintenance; but as regards the third and most important, reduction of air resistance, nothing whatsoever has been done. It would look as though the designers of locomotives and trains were ignorant of its existence.

Careful streamlining has made possible an airplane speed of over 318 miles per hour - the total neglect of it in railroad operation costs, at high speed, about one half of the locomotive power.

Can our fast trains be streamlined? Undoubtedly they can, and at a cost that would be by no means prohibitive. The roof, instead of curving down at the vestibules, should run straight across the gap, with flexible connections, as in the latest Pullman vestibules, with the roof of the adjoining cars.

As matters now stand, the air, closing in behind the locomotive, exerts its pressure upon the trucks of each car of the train. In a 12-car Pullman, there are 24 trucks exposed to atmospheric pressure. At 60 to 75 miles per hour the consumption of power in forcing these trucks against the air is enormous. In streamlining the train, the sides of the cars would be extended down, in the form of light steel plating, and curved inwardly to the rails, with sufficient clearance to avoid switches, and other projections. On a train streamlined in this way the air resistance would be reduced to the head resistance of the locomotive and the friction of the air moving rapidly along the smooth roof and sides of the train.

This proposal is not new. It was tried out experimentally 80 years ago (if we remember rightly) the Baltimore and Ohio Railroad, and the results were highly satisfactory. True, it would cost money; but if it saved only one half of the engine power (50 percent) now expended in overcoming wind resistance, the cost would easily be recovered and a large permanent saving would be shown in the fuel bill.

A REAL ACCOMPLISHMENT

WHAT outstanding achievement has been made in the Coolidge administration, will be a question hurled with increasing frequency as the

first Tuesday after the first Monday in November draws near.

Well, for one thing, there is maple syrup. Heretofore, the only objection

To What End?

FORMERLY, in India, worshippers of Vishnu are said to have cast themselves in a frenzy of fanaticism under the wheels of the great ceremonial car which contained an idol of "Vishnu, Lord of the World," or Juggernaut. Besides serving no purpose, their self-immolation was against the principles of Vishnu's teaching.

The recent sacrifice of his life by Frank Lockhart, racing car driver, to the whim of the modern God of Speed, reminds us of the car of Juggernaut. He cast himself, not under the wheels, but on them, forward at such a terrific rate of speed that his life was forfeit. But why? What question was he trying to solve? That of human endurance or the capabilities of a machine? The first has already been solved in the air to a greater extent than anyone could expect to solve it on land. And in the air there is a definite practical need for this knowledge. The second has been, and may still be, solved in the air, the shop, or the laboratory. Little can be learned by ground racing that cannot be accurately determined otherwise. And it is obvious that such great land speed can never have a tiny fraction of the value of great air speeds.

It is regrettable that this brave young man, who had more "guts" than practical foresight, lost his life, but it is to be wondered what gain has come of his sacrifice. Speed-mania, which has given us our rushing, tense, and tumultuous civilization, has also contributed much to our modern efficiency, has caused much of the progress of which we boast, but purposeless speed should not be countenanced. It is time a protest is registered; public sentiment should stand firmly against any repetition of this meaningless exhibition of devotion to the God of Speed.

to good old Vermont maple syrup has been that there was not enough of it. The morning pancakes of too many of us have been covered with an insipid concoction of "imitation maple" made from a number of ingredients, the principal one in most formulas

being Greek hay seed, or fenugreek, as it is known in the more polite scientific circles. Other ingredients often used to simulate maple flavor have been elm bark, celery seed, hickory bark, coffee, chickory and vanillin.

Now J. W. Sale and J. B. Wilson, chemists of the Food, Drug and Insecticide Division, have perfected a process for making a true maple flavoring product. All you do is mix it with ordinary sugar syrup and you have all the pleasure of the perfect sap. They have patented the process and dedicated it to the public, so that anyone may use it freely. If they can only give enough publicity to their accomplishment, they should be able to swing the entire pancake-eating vote of the country. The up to now solid cornpone vote will be completely disintegrated.

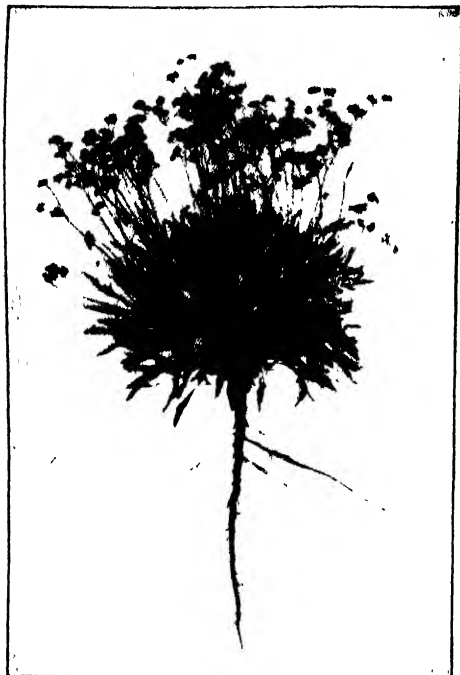
BRIDGES SUPERIOR TO TUNNELS

FOR many years the SCIENTIFIC AMERICAN has urged that bridges are superior to tunnels for the crossing of broad rivers and waterways. They cost less to build, less to maintain, and have a far greater traffic capacity. This is proved by a comparison of two recently completed structures: The Delaware River Bridge at Philadelphia and the Holland Tunnel below the Hudson River.

Figures given out by the bridge authorities show that the bridge cost 37,000,000 dollars and the tunnel 48,000,000 dollars. Maintenance costs for the bridge are about 375,000 dollars per year; for the tunnel the estimate, due mainly to the costly ventilation, is about 1,500,000 dollars per year. The bridge affords three lanes of traffic, the tunnel only two. The hourly capacity for the tunnel is only about one half that of the bridge, yet the toll for automobiles is twice as great.

These comparisons have deep interest for the people of Philadelphia who strongly advocated the building of a bridge in the face of the powerful combination of interests that favored the construction of a tunnel. New York faces the same problem. In a few years the great suspension bridge at Washington Heights will be completed and the proposed bridge at 59th Street must be taken in hand. Otherwise, at least four tunnels must be built to equal the bridge capacity, at a greater first cost and involving a far greater cost for operation. And the cost will be handed along to the public.

Can We Grow Our Own Rubber?



YOUNG GUAYULE PLANT

Guayule is pronounced "wy-oo-le," the initial letter "g" being all but silent

COMPANIONS of Cortez returning to Spain early in the 16th century told Peter Martyr of the Royal Council of Indian affairs of a game of tennis popular among the people of southern Mexico. It was said that "Their balls are made of the juice of a vine that climbs over the trees, as hop vines clamber among the hedges. They cook the juice of these plants until it hardens in the fire, after which one shapes the mass as he pleases, giving it the form he chooses. It is alleged that the roots of this herb, when cooked, give them their weight; at all events I do not understand how these heavy balls are so elastic that when they touch the ground, even though lightly thrown, they spring into the air with the most incredible leaps."

THIS, with other information as to water-proofing cloaks of matting of fiber, constitutes the earliest knowledge of the use of rubber.

Not until the last half of the 19th century was any additional utilization of caoutchouc made. In this period it began to be employed in rain-coats, shoes, hose-pipes, and other articles. No extended demand, however, was made for it until inflammable gasoline, coming as a by-product of oil-refining, was squirted into smoothly bored steel cylinders and ignited rhythmically and the internal combustion engine was born. Horses were unhooked from hundreds of thousands of vehicles, gasoline engines were hidden under the drivers' seats and the commonplace daily world quickened its

Guayule, a Native American Rubber-producing Shrub, Is Being Cultivated on a Large Scale in California.

By D. T. MacDOUGAL, Ph.D.

*Associate in Plant Biology, Carnegie Institution of Washington
Member American Philosophical Society
Corresponding Editor, SCIENTIFIC AMERICAN*

pace from five to 25 miles per hour. Interest then shifted from railways to highways and from common carriers to individual transportation.

This increased speed called for cushioning against jolts and jars to the human anatomy and against breakage of material carried as loads over rough roads. Cores or rings or air enclosed in circular rubber tubes were attached to the rims of wheels to mitigate bumps, save springs and abolish noise: The epoch of rubber was initiated.

SO common has the pneumatic tube become that the number kept inflated in the United States is as great as the pairs of shoes worn by the populace; the count of horse-shoes could also be included without disturbing the equation.

This implies that about six pounds of rubber is necessary on the average for every man, woman and child in America. The total American consumption of rubber requires 66 percent of the world's production, and a further analysis indicates that about 81 percent of the rubber coming into the market every year is made into tires and tubes by the use of which the hypothetical American speed of 25 miles per hour may be maintained.

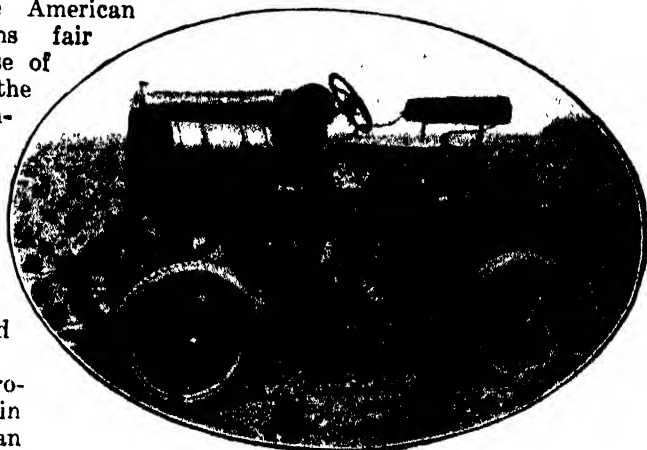
With this material assuming such importance in daily life that it ranks below only steel, sugar, textiles and wood, problems arise which are not to be solved by statistics of production and population. The American consumer who seems fair to continue in his use of more than half the amount produced, controls less than one half of 1 percent of the tropical areas in which rubber trees may be grown profitably. No part of this small area is within the boundaries of the United States.

Material, whether produced in our own or in dependencies of European powers, must be carried long distances by sea to reach American factories.

A country so highly mechanized would be inconvenienced or crippled by a serious interruption of the rubber supply for two or three months. Moreover, there is not in existence at one time enough rubber to meet the world's needs for more than five or six months.

The economic stability of a country depends upon the degree to which it is self-maintenant as to its manufactures and upon the main supplies of raw material within its borders. No dreams of denationalization of the world or of socialization of industries can annul or modify this principle in any serious manner. The results which could be expected if it were necessary to bring our main supply of iron, coal, sugar or wood from the other side of the world are so obvious that the desirability of the production of rubber within a reasonable radius of the factories which convert it into useful articles need not be argued.

THIS must not be taken to mean that effort or other expenditures should be wastefully directed to the production of the total amount of rubber used in a country. It is, however, the soundest kind of common sense that the capacity of America for producing rubber should be developed to an extent in which some land might be more profitably used than at present, unused areas be brought into cultivation, and that other plants furnishing caoutchouc should be exploited.



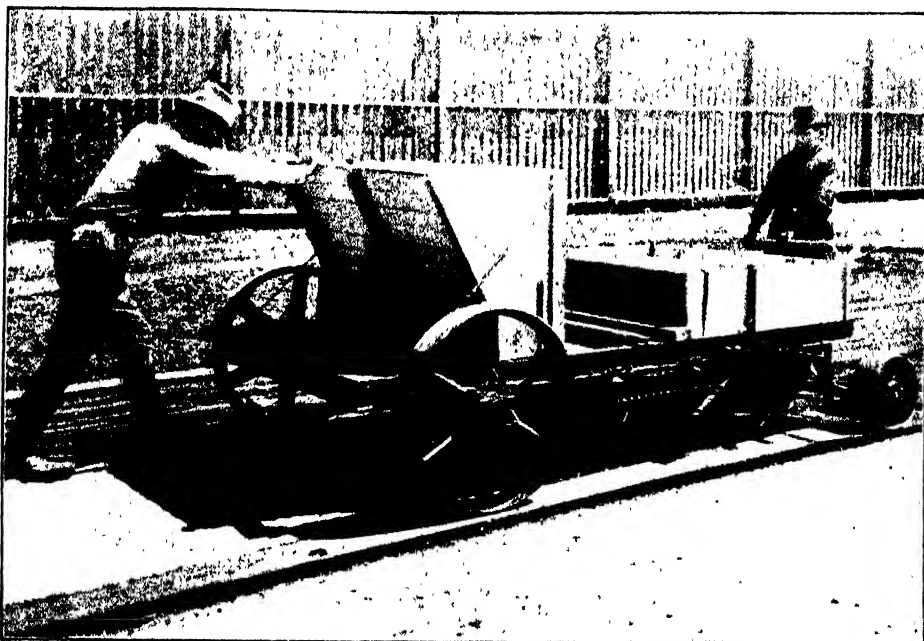
GATHERING GUAYULE SEED

A set of revolving brushes and a "vacuum cleaner" device are removing the dry seeds from a crop of young, pedigreed plants

The main supply of rubber comes from hevea trees of the tropics. Thousands of other species, hundreds of which are native to North America, show some caoutchouc in their milky juices or in the thin-walled cells of the wood. Plants, the dried stems, leaves and branches of which show as much as 1 percent of rubber, are numerous. Several of these cover extensive areas of wild land and constitute a reserve supply which might be profitably drawn upon if raw rubber rose to ten dollars per pound. A similar state of affairs with regard to starch prevails. Grains and potatoes furnish the main supply. In extremity thousands of other plants might be used as sources. Lastly, any attempt to produce rubber within the limits of the United States upon any basis except that of a self-sustaining branch of agriculture would be justifiable only on a basis of the gravest menace to the national safety. The only pound of rubber of real importance is one in which the grower has made a profitable use of his land, labor received a fair compensation and the manufacturer a safe return on his capital and operation.

SUCH considerations must be taken into account in the widespread agitation now being made as to the production of rubber in America. The first successful attempt to grow rubber in the United States on a self-sustaining basis without government subsidy or aid and as a sound commercial project is to be credited to the Intercontinental Rubber Company. This company, with its allied interests, has been engaged in the extraction of gum from dried shrubs of the guayule plant collected chiefly from its extensive holdings in northern Mexico for 22 years. Its output has run as high as ten million pounds monthly, with a total from the guayule plant of about 150 million pounds annually.

From these figures it is evident that guayule is second only to hevea in contributing to the world's supply. In making this yield, however, the



A SPECIAL SEEDER OPERATING IN THE NURSERY

The seedlings are grown in 180 foot rows. Seed for 25,000,000 plants was sown last April. The seeder runs on wooden tracks and will sow enough seed for a 20-acre field in an hour

history of all wild plants utilized in manufactured products is illustrated. The peak of the manufacture of material was shortly followed by decimation of the stand of wild plants. It is estimated that the "forest of guayule" which covers about 130,000 square miles in Mexico and southern Texas could not be managed to yield more than 5000 tons of rubber annually.

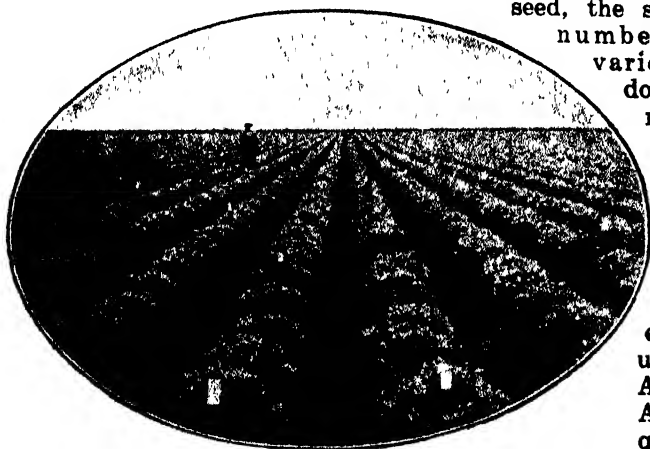
WHEN it becomes evident that attempts at a greater production from wild plants would mean a dwindling industry, a serious scheme for research and experimentation was undertaken to bring the wild plant into cultivation. The implied experimentation was placed under the hands of Dr. W. B. MacCallum, whose previous experience and personal qualities gave him special fitness for the "domestication" or, more properly speaking, the subjugation of the wild plant.

The technical problems pertaining to the harvesting and germination of seed, the selection from the vast number of recognizable varieties of the half dozen which might be most profitably grown in fields, and the determination of the hundreds of details of practice which make for success or failure of any crop plant were studied in experimental plots and under shelter in Mexico, Arizona and California. As an onlooker and frequent visitor to the plantation the author is vividly conscious of the hundreds of discouraging features

encountered. The combination of the facility of a skilled plant physiologist, and the resourcefulness of a trained engineer with a total expenditure running into seven figures was necessary to complete the first stage of the project. At this juncture the management had acquired small lots of seeds of less than a dozen varieties of the shrub, the seeds of which could be used to grow plants with a higher percentage of rubber than the wild plants, and some pretty definite knowledge of a practicable method of growing crops of the improved varieties. This, with some clear ideas as to the soil conditions and climate best suited for guayule, represented the results of 14 years work.

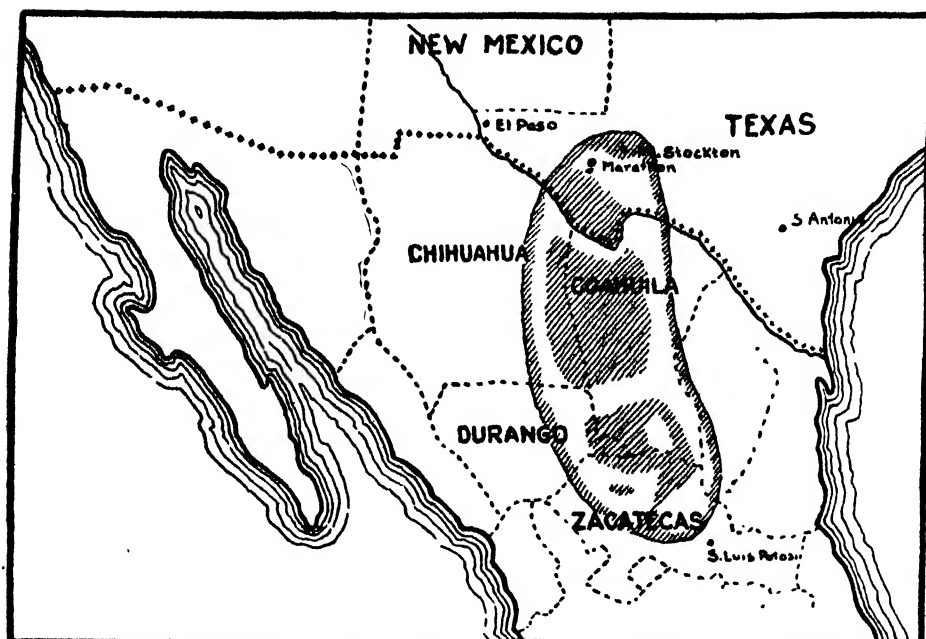
GUAYULE is now to be included among the plants which may be grown profitably upon some hundreds of thousands of acres within the limits of the United States. Its cultivation in other countries is a matter for further experimentation. The domestication of a wild plant, so that it may be grown as a field crop within the brief period indicated, is without parallel in the history of agriculture, and is an accomplishment which for speed keeps pace with scientific research and invention during the last 20 years. That the best possible procedure in all phases of the industry has been found is highly improbable; for comparative example, we are still improving the yield and methods of milling wheat after having this plant under cultivation for five to ten thousand years.

Many thousands of wild plants and especially trees are grown under control. The rubber plantations of the Far East have come from seeds of hevea collected from trees on the upper Amazon about a half century ago. So far, the record of any actual im-



MAKING VARIETY TESTS

The plantation described in the article is situated at Salinas, California. Guayule shrubs require frost but no irrigation



NATURAL RANGE OF THE WILD GUAYULE PLANT

There are over 1000 varieties of the wild plant. At Salinas, 2600 acres are under actual cultivation. Salinas is in California, near the seacoast, 100 miles south of San Francisco

provement of strains or modification of the tree by man are scanty.

The essential feature of a field crop is that its seeds should be made to germinate so nearly simultaneously, and the plantlets to grow so uniformly, that hundreds of thousands or millions may mature their grain, fiber or other products at the same time. If some heads of wheat in a field ripened in June, others in July and others stayed "in the milk" until August the difficulties of the farmer would be much greater than those of which he now complains.

THE production of a crop of guayule on the California plantations of the organization mentioned involves the following program: Seeds from desirable varieties having been gathered by specially devised harvesting machines from standing shrubs, which are not injured by the process, they are subjected to special treatment so that 98 out of every hundred germinate. This is literally first aid, since in nature many of the seeds may not sprout for weeks, being subject to rot and destruction. This would result in a lot of plants of widely different ages and development. Sowed in the nursery in the spring the plantlets come up of uniform height and in about nine months are ready for transplantation to fields. There they are spaced in rows to give each one about six square feet of soil, and allowing 7260 plants to the acre.

Every one of these young plants is to be regarded as a factory unit driven by its own solar engine which in three or four years will build up its own roots, shoots and leaves until it attains an average weight when dried of one and three quarters pounds, of which 12 to 14 percent may be pure

gum or rubber. The separate plants are handled but twice on their way from the seed-beds to the fields.

The remainder of the transplantation process is mechanized. Such a procedure is in accord with a principle now coming into recognition, that the most successful agriculture is that in which the greatest production of an acre is accomplished with the least expenditure of man power.

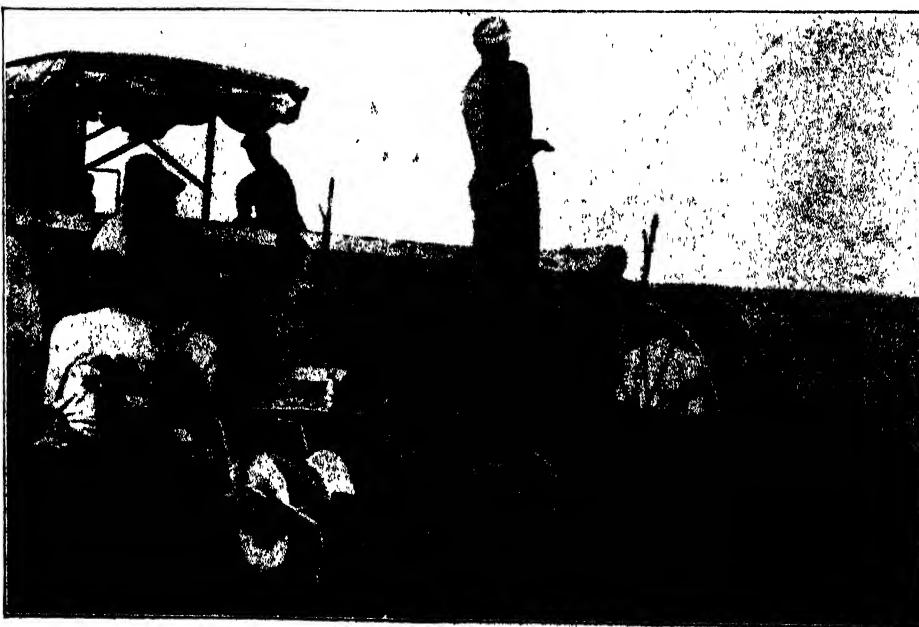
The tree rubber of the Far East is produced under a system in which the daily work of one man for a year results in the production of 1600 pounds of rubber. Even in the present initial stage of culture, with possibilities of improvement, the work of one man on a guayule plantation for a year brings 25,000 pounds of rubber.

The planted fields of guayule, as shown in the illustration, must be kept free from weeds for the three or four years during which a profitable increase in the size and rubber content goes on. Actual increase of the amount of production on each acre continues for 10 or more years, but the rate of accretion slows down so that as the end of this period nears the caoutchouc formed yearly would barely meet the annual cost of tillage.

THE condition just described is, however, an advantage in another way to the cultivator: if the market or the milling facilities should be overcrowded at the time of the fourth year harvest, the crop may be allowed to stand for as long as four years more, during which there will be a sufficient increase to meet interest and maintenance charges, as would be the case in certain forestry operations. In fact, guayule culture is something like a forestry project of short cycle.

Very few cultivated plants of any kind reach their greatest usefulness or productivity in the regions in which they are indigenous. The ancestors of maize were native in the elevated desert regions of southern Mexico in which the climate is widely different from that of New York or Iowa. Maize culture has been carried northward over 30 degrees of latitude, from southern Mexico and from coast to coast and it may encircle the world.

Briefly put, the production of rubber by guayule is best conducted in a region in which a part of the season has precipitation, soil-moisture supply and a temperature favorable to growth of stems and roots and to the formations of sugars in the leaves, followed by periods of higher temperatures with lessened precipitation.



THE TRANSPLANTER SETTING FOUR ROWS AT ONE TIME

This is much like the common cabbage and tobacco transplanter used elsewhere. A small plow opens a drill ahead of the men, the seedling is placed in it and a following tool covers it

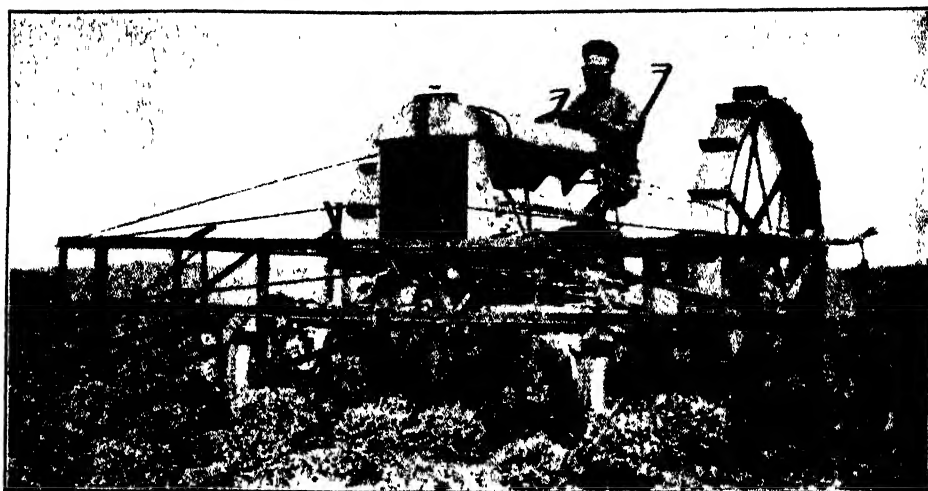
What pattern may be made by guayule on the map during the next half century can not be foretold, although the experts in the project doubtless have well grounded opinions on the matter. The next step will doubtless be the discrimination among varieties, in order to find the ones most suitable for the coldest regions for the least water supply; also for long seasons, for short seasons, for various types of soils, for three year crops, for four year crops and perhaps for wild sowing on grazing areas.

WHEN the crop on a certain area has reached the age of three or four years and the percentage of rubber is found to be satisfactory, the plants are all pulled up with the roots attached, dried in the open air and crushed by being sent through series of rolls in the presence of water. According to Dr. Spence's technical account—"After crushing, the mass is fed continuously with additional water to a tube mill or mills. These mills contain flint pebbles and revolve slowly on a horizontal axis. Their action on the shrub depends on the rolling motion of the pebbles in the presence of water and results in a further disintegration of the fiber out of the shrub and the agglomeration, or 'worming,' of the rubber substance into small, round, spongy particles, which vary in size with the condition of the shrub and the time of milling. The fine particles of rubber, or 'worms' being lighter than water, float on the surface of the discharge liquor from these tube mills, while the bulk of the fiber and other impurities sinks and can be readily separated. The rubber 'worms' which rise to the surface of the settling tanks into which the liquor from the tube mills is run, are skimmed off and collected. The 'worms' are further purified and are then worked into sheets on sheeting rolls, well washed and dried."



TWO YEARS OLD

Guayule is Parthenium argentatum. Argentatum refers to the plant's silvery leaves



CULTIVATING—SIX MONTHS AFTER TRANSPLANTING

A modified farm tractor carrying a cultivator rigidly attached to its front, is employed. This enables the operator to watch his work closely. Four rows are covered at each trip

Tests under the direction of the United States Bureau of Standards "indicate that, when properly prepared, the rubber from guayule will compare favorably with that from

of latitude, and from the moist tropics to regions in which the rainfall is too low for the advantageous production of grains.

This addition to the agricultural products of temperate America is not to be regarded as a means of putting the tree plantations of the Far East out of business; such an effect would be highly disadvantageous to the consumers of rubber everywhere. To the economists who might call attention to the fact that the area in the tropics in which tree rubber might be produced is ten times that now occupied, it is to be pointed out that the critical feature of the industry is power. It is generally assumed that tropical natives may be relied upon to furnish indefinite numbers of laborers. In contrast with this careless view it may be said that attempts to expand rubber production in Malaya where 750,000 coolies are already employed have been checked by lack of man power. It may be safely predicted that consumption will soon increase more rapidly and that other countries than the United States will require the entire tropical crop.



THE PLANT NURSERY

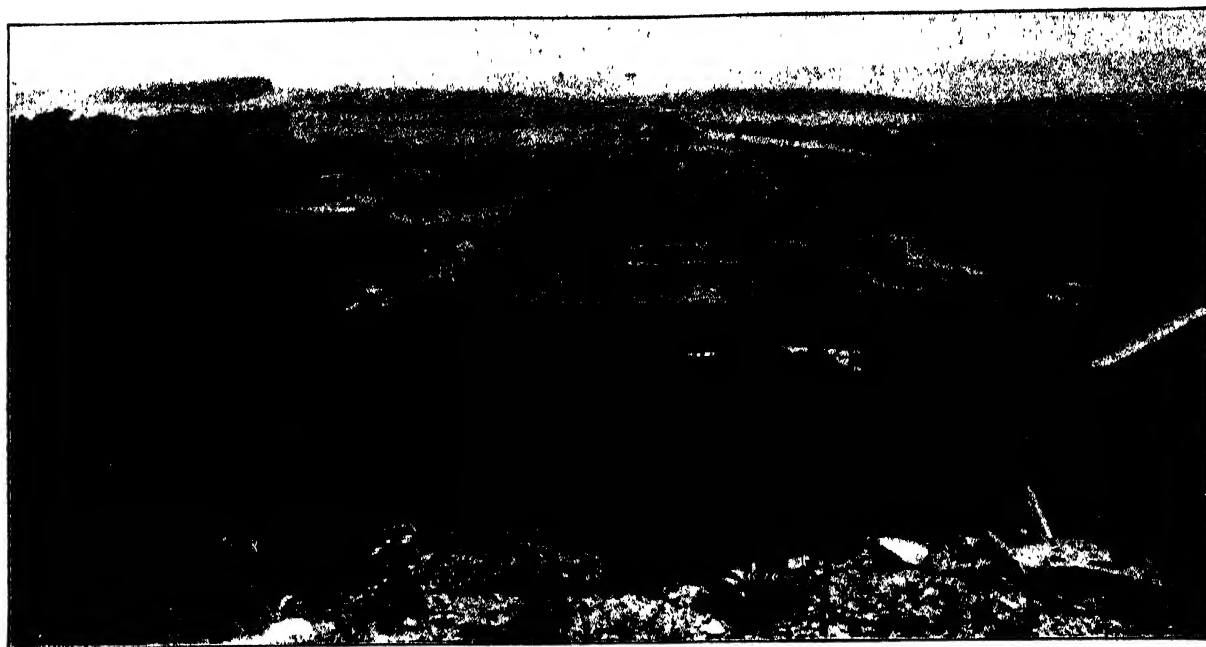
Part of the seed beds in which 18,000,000 plants, four months old, are growing

hevea and can be used to a large extent therefore without appreciable diminution of the tensile elongation product" (Technological Papers, United States Bureau of Standards, Number 353, 1927).

THE experiments with the guayule shrub, described above, have resulted in the domestication of a wild plant within 16 years and the production of rubber as a field crop with a cycle of three or four years. The application of engineering principles, including the use of specially designed machinery, has made it possible for one laborer on the prevailing wage standards to do the work of 16 on a tree plantation in the tropics. The profitable cultivation of rubber-bearing plants has been extended from the tropics northward through 25 degrees

IN such a case it is of interest to know that 40,000 farmers and mechanics employed in guayule cultivation could meet the need of the United States during the next 10 or 15 years.

The possibilities of such production outside the tropics and in the North Temperate zone would in itself be valuable insurance against many hazards including those of diseases of rubber producing trees. When it is recalled that 92 percent of a raw material that has become essential to the material operations of modern civilization must now be brought overseas and half way around the world, and that the accumulation in America is never more than sufficient to keep factories in operation for more than 100 days, the importance of rubber culture as described becomes apparent.



LIKE A GROWING MOUNTAIN

Striking view of the advancing fill, showing the beautiful valley which it traverses. To get an idea of the size, note the horse and

wagon crossing on the road beside the culvert. In the upper left corner may be seen the steel bridge which the fill supplants

A Mammoth Railroad Fill

Original Timber Trestle Is Replaced, First By Steel Bridge, Then By Massive Earth Fill

By J. BERNARD WALKER

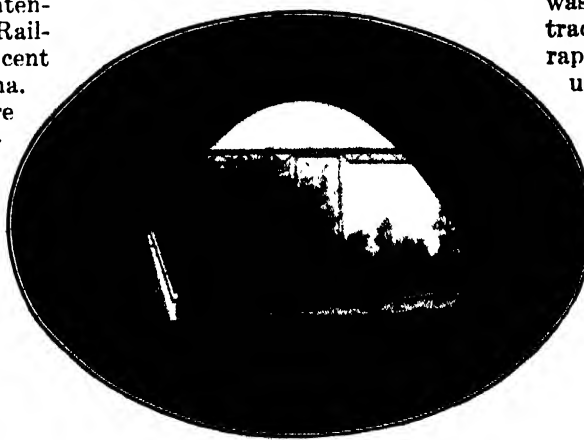
THE development of the American railroad from its crude beginning to its present-day costly perfection has been marked by three rather well defined stages - the pioneer; the intermediate; and the modern. Those of us who were privileged to attend the Centennial of the Baltimore and Ohio Railroad, saw, in that truly magnificent spectacle, the complete panorama.

When the pioneer roads were undertaken, experience was wanting and capital was scarce. It was necessary to cut the cost according to the cloth. If the roads were to be built at all, they must be built cheaply.

HENCE, when the engineer who located the line came to a hill, he ran around it rather than through it, following the contours of the hillside, disturbing the ground as little as possible, and avoiding deep cuts and heavy fills. This economy called for sharp curves and steep grades.

Structural iron and steel were scarce and their price was prohibitive. So when the engineer came to a valley or canyon that was too deep for a fill, he set up a sawmill in the forests (always within reach) and spanned the gap, quickly and cheaply, with lofty wood

trestles. He drove wood piling piers into the bed of the rivers, and crossed them by that remarkable framed structure, the Howe truss bridge. Timber for these trestles and bridges was not only abundant but cheap, and the only iron or steel requirement was some



FROM UNDER THE CULVERT

This huge culvert, 45 feet wide and 25 feet high, was necessary to carry heavy flood waters of the creek through the new fill

simple round bars, threaded at the ends. Thus, by these simple methods and at remarkably low cost, did our forefathers, during the first railroad era, push boldly through the forests and mountains of virgin America.

Then followed the second period,

from the Civil War to the close of the century, when the nation turned its energies to the opening up of the great western territory. Thanks to the Bessemer process and the development of the steel mills, excellent structural steel became available at a cost that was not prohibitive, and the network of tracks began to spread with amazing rapidity—the western extensions still using soft wood timber for bridging and ties; the eastern roads, now better established, making use of steel in increasing quantity.

By the opening of the Twentieth Century, the period of construction closed; henceforth, as the roads prospered and capital became abundant, the gigantic task of reconstructing the pioneer roads to meet the engineering and economic demands of the day was boldly faced and carried through.

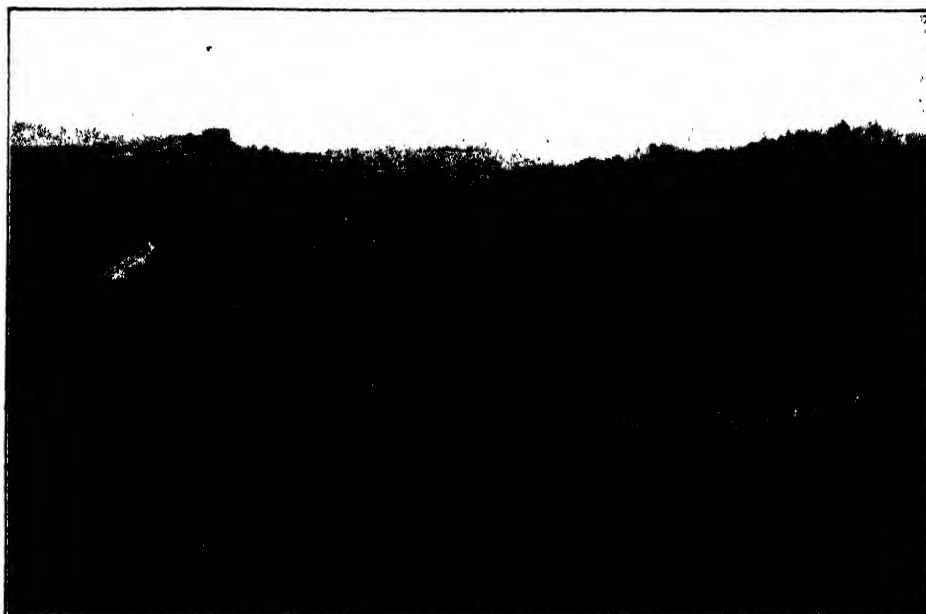
DURING the past three decades, hundreds of millions of dollars have been spent in relocating certain stretches of railroad; in reducing curvature and grades; in replacing bridges, both wooden and steel, with heavy steel structures capable of carrying the heavy locomotives and cars of today.

The modern railroad, as thus rebuilt,

aims at permanence and the reduction of the repair and replacement bill to a minimum. A notable instance of this is seen in the practice, where it is possible, of substituting solid rock or earth embankments in place of wood or steel viaducts. Sometimes the fill is made around the existing viaducts, but preferably, where this is possible, the great fill is located independently of the old line, and undesirable curvature is eliminated.

A notable instance of this revision is shown in the accompanying illustrations of the great fill at Ringtown on the Catawissa Branch of the Reading Company, which has taken the place of the well-known steel viaduct at that location. The line on which the viaduct is located carries a heavy coal traffic, to handle which, the locomotives and cars have been greatly enlarged in power and capacity and the length of the trains increased. To meet this exacting service the roadbed, bridges and track have been steadily improved, the weight of the steel rails, as elsewhere on this system, having reached the high figure of 130 pounds per yard.

ORIGINALLY, the valley of Ringtown was crossed by a timber trestle which figured in the great Molly McGuire riots, when a determined, but unsuccessful, attempt was made to burn it down. It differed constructively from the great timber viaducts on the western railroads, several of which are still in service. In the latter the vertical posts are solid timbers, 12 inches and sometimes 14 inches square, and they are built in decks, with transverse caps of the same dimensions, the top deck consisting of 8 inch by 16 inch stringers, bolted together in pairs, upon which the ties were bolted down. Probably because of the difficulty of obtaining timbers of this size for the



HOW THE FILL WAS BUILT

Behind the loading station is a train load of material which will be discharged into work-cars and dumped over curve at end of the fill. The work-car track was advanced as the fill progressed.

Ringtown trestle, the verticals were built of two timbers, bolted together with separator blocks between. An excellent feature was the abundant provision of longitudinal braces in each deck of the structure—a feature in which the western wooden viaducts were apt to be wanting, at times with disastrous results. The average space between the bents was 16 feet; but in this structure the span was increased, the necessary carrying strength being secured by providing a stiffening truss in each span.

In the year 1897 the wooden structure was replaced by a steel viaduct. This consisted of steel piers, consisting each of a pair of widely spaced steel bents, carrying plate girders with shallow deck trusses between the piers. This bridge gave good service

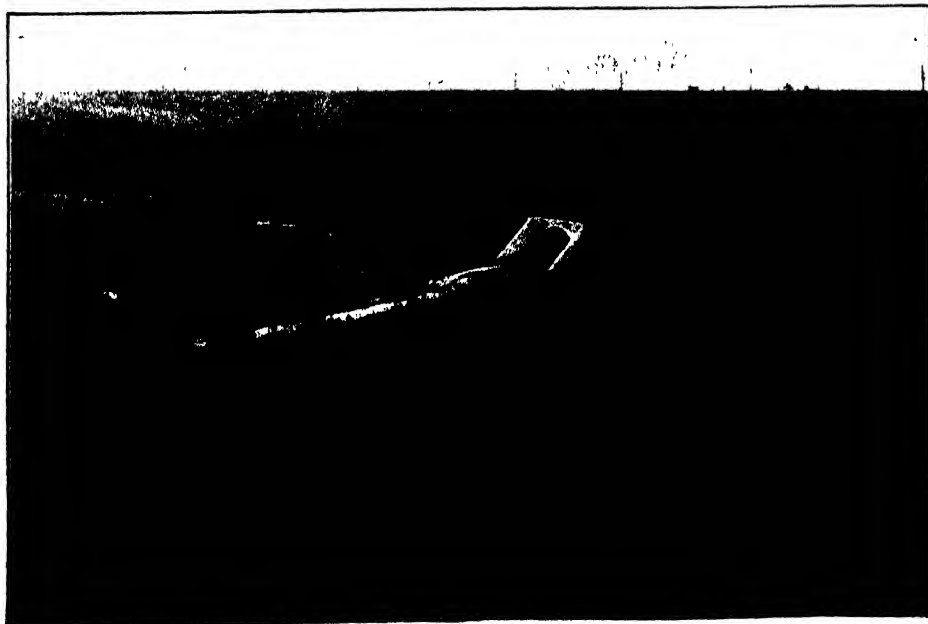
until the year 1922, when it was determined to relocate the line straight across the valley at a short distance from the existing location. The work was commenced on April 4, 1922 and completed on November 19, 1927. The new line was placed in service on September 11, 1927. The length of the fill is 3340 feet; its maximum height is 116 feet; and its maximum width at base 368 feet. It contains 1,352,613 cubic yards of material, and the total cost was 1,200,000 dollars.

THE stream which flows through the valley is subject at times to heavy floods, to provide for which it was necessary, before making the fill, to build a massive concrete culvert from toe to toe of the embankment slopes. It is 45 feet wide, 25 feet high above bed of stream, and measures 430 feet between the ends of the retaining walls.

The material for the fill was brought to the site in standard cars, unloaded to small work cars, hauled out and dumped on a curve at the end of the fill, the empties being hauled back to the transfer house which was located at the far end of the fill.

While the Ringtown Fill, described in the foregoing story, represents what is probably the greatest earth fill on any railroad, the amount of soil used cannot compare with that used in some earth-fill dams. A number of these, of tremendous size, have been constructed, but the dam planned for a hydro-electric development of the Lexington Water Power Company (a subsidiary of the General Gas and Electric Corporation) near Columbia, South Carolina, is said to be the largest.

This dam, representing the major item of construction, will be 8000 feet long and 208 feet high. Contract for the dam's construction was let in August, 1927.



THE COMPLETED FILL

View taken from the track leading to the old steel bridge. Here may be seen the massive culvert which passes through the fill. For comparison of size, note group of men on fill over culvert.

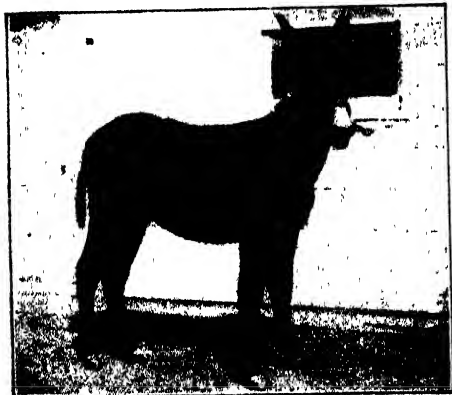
From the Scrap-book of Science—



Underwood and Underwood

FOR OUTSTANDING RESEARCH

Professor William R. Harkins of the physical chemistry department of the University of Chicago was recently awarded the Willard Gibbs Medal by the American Chemical Society for researches, one of which will have importance commercially in lubrication



UNUSUAL HYBRID

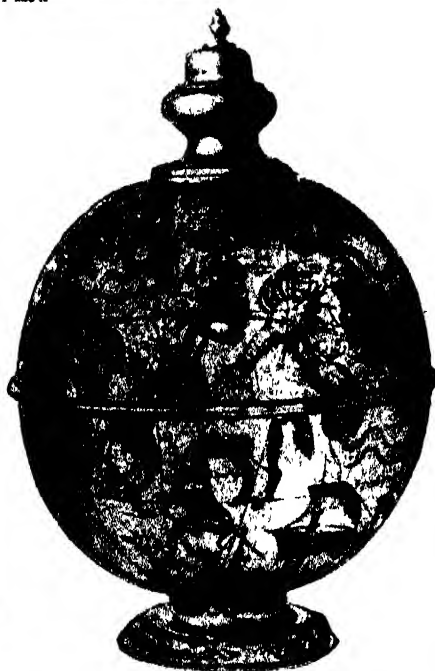
Three fourths ass and one fourth horse, this animal was foaled by a mule and was recently acquired by the University of Nebraska. Hitherto the opinion has been that a mule cannot become a mother. Ichabod, as this animal is called, is said to be strong and well developed, and travels with a gait similar to that of the horse. He was born on a Nebraska farm



F and A

BILLIARD TABLE

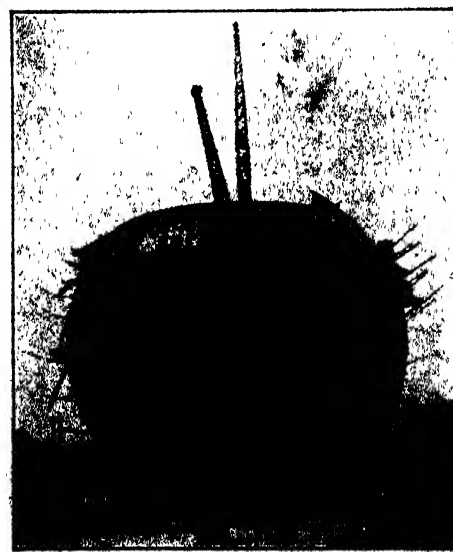
Slate splitting is an art acquired by long practice. Welsh quarries employ many skilled men but it is unusual as a Thames-side occupation. In this illustration, two workmen are "floating" a billiard table bed made of five slabs of slate, planed and joined together, at the Dinorwic Slate Wharf, Rotherhithe. This is done by rubbing the slabs with floats which are made of metal boxes filled with a mixture of sand and water. Care must be used in selecting the most suitable slabs



Wide World

ASTRONOMICAL BALL

At the American Museum of Natural History this great silver ball-map of the heavens, 12 inches in diameter and valued at 108,000 dollars, was recently placed on exhibition. It is 400 years old and is the work of Tycho Brahe, the noted astronomer



F and A

FOR DIABETES TREATMENT

Although not substantiated by independent research, the treatment for diabetes developed by a Kansas City physician will be practiced in this unique steel tank which is part of a million dollar sanitarium being built in Cleveland. The treatment is kept secret but it is understood that introduction of oxygen under varying pressures into the blood of the patient is one of its features. The tank is 64 feet high, contains five stories and will accommodate 40 patients. It is connected with a 60-patient sanitarium by a covered passageway

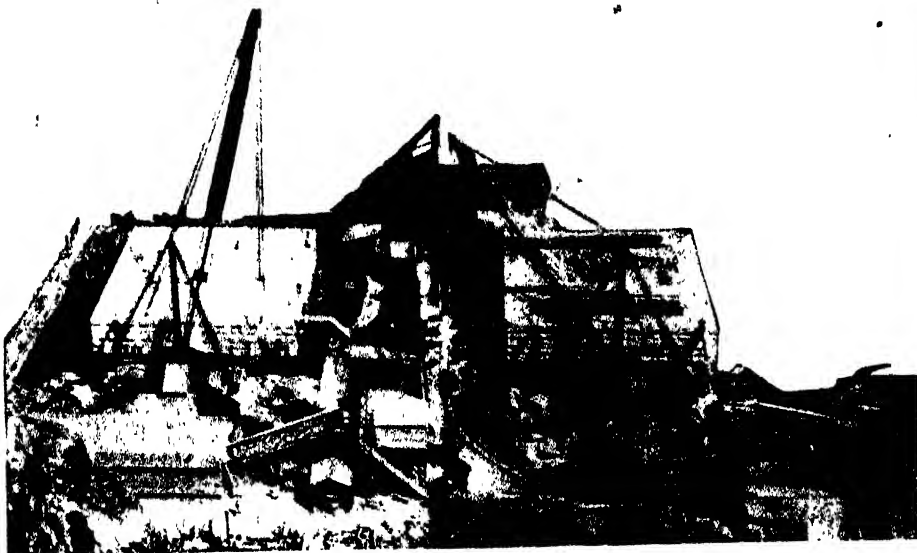


INVENTIVE CHEMIST

Percy W. LeDuc, chemist of the Biochemic Division, Bureau of Animal Husbandry, Department of Agriculture, saves the government thousands of dollars a year by his inventions. He is shown with his machine which covers with glue the stoppers of tuberculin bottles. The use of sealing wax was more costly

F and A

Camera Shots of Scientific Events



BRIDGE-TO-BE

Satisfactory progress is being made in the construction of the massive piers that will sustain the load of the future bridge spanning the Hudson River from Fort Lee, New Jersey, to Fort Washington, New York City. This illustration shows the piers on the New Jersey side completed, ready for the main columns which will be of silicon steel, encased with masonry. Bed rock was reached at depths varying from 35 to 75 feet below water. A steel coffer-dam protected the work



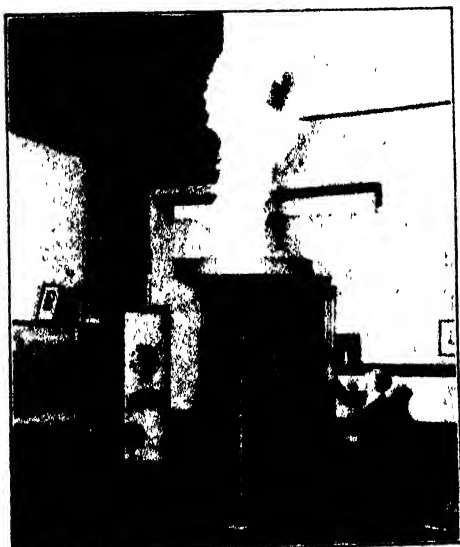
"THANK YOU-U-U!"

So says the voice from this new automatic cigarette vending machine; and follows this by the spoken slogan of the particular brand purchased. A battery of these venders has been installed in New York City in a Broadway cigar store of a national system



BIGGEST BELT

What is said to be the largest power belt in the world has just been built at Oakland, California. It is 1020 feet long, 42 inches wide, and is valued at 9000 dollars. It contains 10,000 pounds of rubber and 9000 pounds of cotton fabric in eight plies



CLASSROOM GEYSER

Professor B. J. Spence, of Northwestern University, built this model of a geyser to work on the principle suggested by Bunsen in 1847. Water and steam spout to a height of six feet every 10 to 15 minutes. Gas flames (shown on floor) heat the water in the tapered tube until that at the bottom reaches the boiling point—higher than usual because of pressure above; the hot water expands, rises, and becomes steam since its critical temperature is lower; and the steam, rising rapidly, carries the water above it six feet into the air



TRENCH DIGGER, CABLE LAYER, TRENCH FILLER

Only six men are required to operate this new German machine which first digs a trench, then lays the cable and finally fills the trench with soil—all in one operation as the monster moves along. It will be noted that the cable truck brings up the rear, the cable being carried forward along the arm to a point in front of the soil dumping tube. The machine at the left digs the trench and tows the truck

Problems of Solar Research

Many Perplexing Puzzles Have Given Way to Astrophysical Research, but Enough Remain to Keep Astrophysicists Occupied

By HENRY NORRIS RUSSELL, Ph.D.

*Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mt. Wilson Observatory of the Carnegie Institution of Washington*

THE great luminous clouds which extend high above the surface of the Sun have been known for a century or so. They were first observed as brilliant scarlet specks at the edge of the dark Moon during a total eclipse. A little later measures were made which show that the Moon, as it moved across the face of the Sun, moved across these bright objects too, hiding some and uncovering others and making it evident that they were attached to the Sun and not to the Moon—whence arose the old-fashioned name of "solar protuberances," now altered to "solar prominences."

While study of these prominences was restricted to the few minutes of an occasional eclipse progress was slow, but sixty years ago Janssen and Lockyer proved that they were masses of luminous gas and that by isolating with a suitable spectroscope the particular kinds of light which they gave out strongly, they could be observed any clear day independent of an eclipse.

IT was then soon found that the prominences rise from a continuous layer of gas thousands of miles deep and called the chromosphere, which envelopes the whole surface of the Sun. Most of them are of a quiescent type, retaining their general shape and size for days and occasionally for many weeks; but some are evidently eruptive and change with extraordinary rapidity, moving at speeds which sometimes exceed 100 miles per second.

The invention of the spectroheliograph in 1890 by Hale and Deslandres made it possible to obtain admirable photographs of the prominences, giving a permanent record of their forms and motions, and a great wealth of facts is now available for the investigation. The interpretation of these facts is not always easy. The spectral lines show that the principal constituents of the quiescent prominences are hydrogen, helium and—calcium. The first two are light gases and might be

expected in the upper parts of the Sun's atmosphere; but why should calcium, which is a metal with rather heavy atoms, accompany them when other metals were apparently absent?

Further puzzles appeared. What forces caused the extraordinarily rapid motions of these explosive prominences? Why do these forces some-

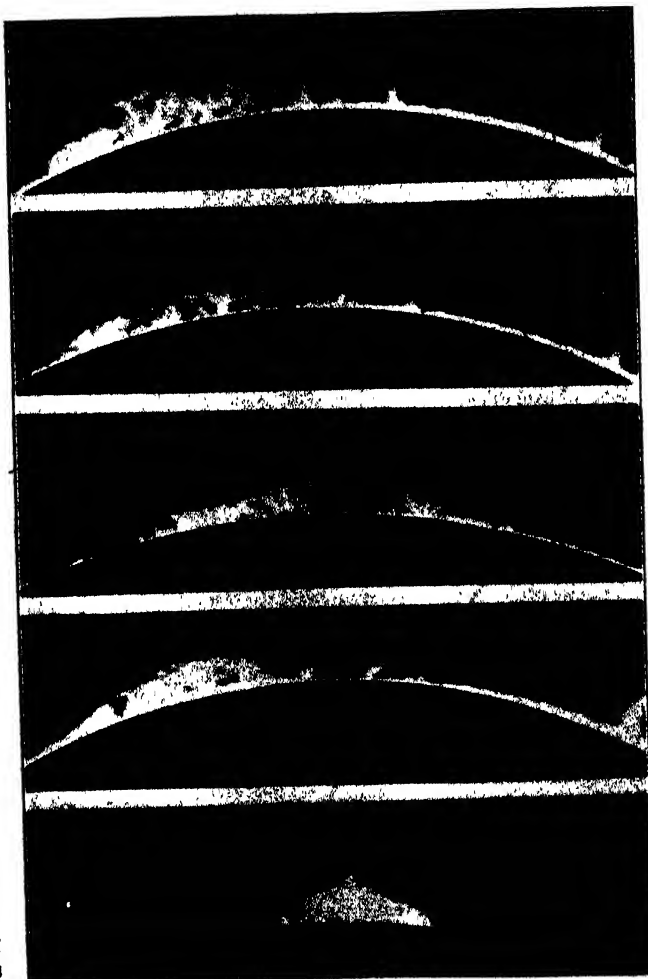
half an hour. Yet the prominences remain in position without visible means of support for days. What holds them up?

Finally, the chromosphere itself is a puzzle. Under such a powerful force of gravity the upper layers of gas should compress the lower by their weight. The simple calculation shows that even for the lightest gas, hydrogen, and for the high temperature of about 5000 degrees, Centigrade, which prevails above the Sun's surface, the density of the gas should double for a vertical descent of 100 miles, double again in the next hundred, and so on. The transition from gas as rarefied as to be practically indistinguishable from a vacuum, to gas so dense as to be opaque, should take place in a depth of a couple of thousand miles at most; for heavier gases, in a hundred miles or so. Yet the observations show that the chromosphere is six or eight thousand miles deep and that it does not appear to be much denser at the bottom than at the top.

IT is again evident that some force must be at work to hold the chromosphere up. What is this mysterious power that counteracts and sometimes overcomes the Sun's mighty attraction—that can hold up heavy atoms as well as light ones and push them sidewise as well as upward? The answer is now certain; it is the vast flood of radiation—light and heat—which escapes from the solar surface.

A body upon which light falls experiences a force—radiation pressure—which

tends to drive it in the direction in which the light was moving. For light of moderate intensity such as sunlight at the earth's distance, this force is small and influences only very small dust particles such as probably occur in the tails of comets. Nearer the Sun both radiation pressure and gravity increase, but in the same ratio, so that again only small particles are affected. Atoms are so small that the light



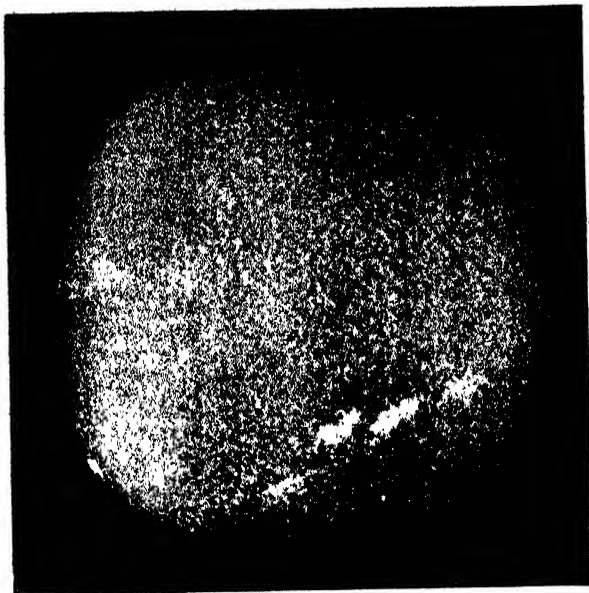
Yerkes Observatory

CHANGES IN A SOLAR PROMINENCE

The great "banyan tree" prominence of 1910 lasted from March 17 to April 28. The five spectroheliograms show its evolution

times work, not vertically away from the Sun, but sideways, as is clearly shown by observed lateral motions of bright knots in some prominences?

Strange as the eruptive prominences are, the quiescent ones are in some ways stranger. The force of gravity near the Sun's surface is very great. An unsupported body would fall 450 feet in the first second, 300 miles within a minute, and 280,000 miles in



Yerkes (Herschel story)

BRILLIANT CALCIUM FLOCCULI

These are great clouds of luminous calcium vapor in the atmosphere of the Sun, far larger than the earth

waves would go past them without disturbing them, were it not that the atoms themselves can absorb light. Light of the particular kinds which the atom can deal with will be absorbed and bear a powerful influence upon the atom. If, then, an atom near the Sun in its upper atmosphere absorbs light within the range of wavelength which the Sun gives off powerfully it will be subject to radiation pressure which may weaken the effects of gravity or even overpower them.

Now atoms of calcium (in the ionized state with an electron gone, in which they are pretty sure to be in hot rarefied upper layers of the solar atmosphere) absorb very strongly in a region where the Sun's radiation is itself strong, producing the great *H* and *K* lines in the violet.

Calculations by Milne have shown that such atoms, if exposed to the full intensity of sunlight undiminished by the weakening which occurs in these lines, would be powerfully repelled from the Sun and fly off at a great speed into space. As a matter of fact, these absorption lines produced in a lower atmosphere by calcium atoms which are entangled among a host of other atoms of all sorts and cannot escape, automatically adjust themselves to just such intensity that the remaining residual radiation almost exactly suffices to balance gravity. The heavy calcium atoms are thus held up in almost perfect balance and the great height of the chromosphere and the great height of the prominences are explained.

IF once a calcium atom, or a cloud of them, got started upward, things would change. On account of their motion they would no longer absorb radiation corresponding to the

middle of the line in the solar spectrum, but to a wavelength on the violet edge of the line where it is not so dark. Radiation pressure would now overbalance gravity and the atoms would be urged upward at an ever-increasing rate. This process may seem to account in a general way for the upward acceleration exhibited by the great detached masses of the eruptive prominences, although many details of the observations remain puzzling.

Finally, the lateral motions of some jets and spikes of prominence material have recently been very ingeniously explained by a young Englishman, Mr. Pike. Observations show that the material in these jets is apparently attracted toward sun spots and even sucked into them at speeds which may reach 50 miles per second, while there are other regions from which the gas appears to be ejected and repulsed. Mr. Pike suggests that these repelling regions are faculae—the occasional bright areas surpassing in brilliance the rest of the photosphere. Such regions would exist in unusually strong radiation pressure, and drive the prominence forming gases away from them at an ever-increasing rate, the spots being cooler and darker than the rest of the surface.

IF the spot were not there the horizontal portions arising from all parts of the Sun's uniformly luminous surface would balance one another. If a spot should suddenly appear, the diminution of radiation pressure away from it while that in all other direction was unaltered, would lead to an apparent attraction.

Gas about a spot, too, would not be held up strongly enough to balance the whole force of gravity, hence there would be a tendency for prominence material to move toward the spot, both laterally and downward. Detailed calculations show that velocities as high as 50 or 60 miles per second may be reached under the combined influence of the repulsion of a facula and the "attraction" of a spot, and that the path of a moving mass of gas would be of very much the shape which is observed.

Great progress has therefore been made in interpreting the strange and at first sight inexplicable behavior of the prominences, but there is much that remains to be done.

We can explain the absence of most of the other abundant metals from the prominences. At this very low density their atoms would doubtless be ionized.

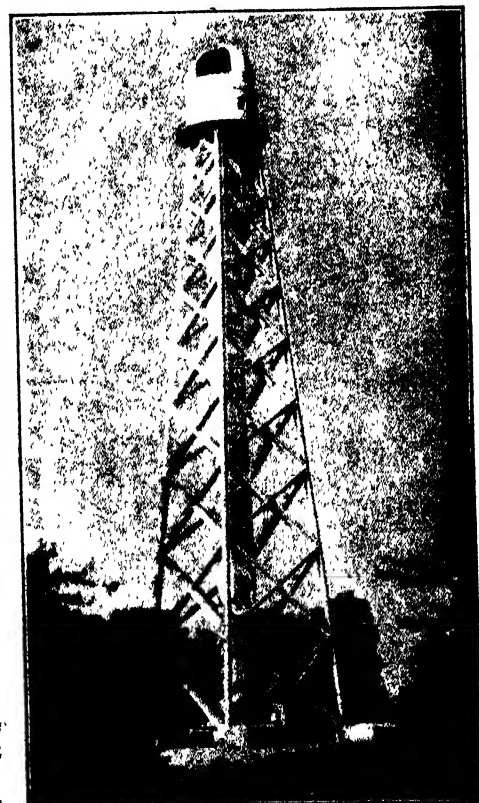
Now very few ionized atoms have their strongest lines in the region of the spectrum which is observable in the Sun. Those which do—strontium, titanium and even the very rare metal scandium—show up in the chromosphere and prominences. Others, like iron, have lines farther in the ultra-violet where the Sun's radiation is relatively weak and may be insufficient to hold up heavy atoms. For other atoms, such as sodium, the corresponding lines are still farther out and there is no hope of their being supported.

But the behavior of hydrogen and helium remains a puzzle.

THESE atoms are so hard to ionize that we need not consider its complications, but their strongest lines are so very far in the ultra-violet that they do not come in to the reckoning at all. The visible hydrogen lines must do a great deal toward keeping the hydrogen atoms afloat in space but the helium lines do not show an absorption at all, although they are strong in the chromosphere and prominences. Here is one of the puzzles which is not yet solved.

The astrophysicist is in no present danger of weeping because he has no more worlds to conquer.

Q Can we go to Mars? Writers of scientific fiction have played with this idea for decades and given it a bad name. Next month we shall tell of some serious thinking on the problem which, while far from solution, is no longer a dream.



Mt. Wilson Observatory

THE SNOW TELESCOPE

Two mirrors atop the tower reflect the Sun's image downward into a deep well

Man's First Mechanical Achievement

Ancient Man's Stone Implements Passed Through a Definite Evolution

By J. REID MOIR

Fellow of the Royal Anthropological Institute of Great Britain and Ireland
With drawings by the author

THERE are very few people, it may be supposed, who, after making an examination of the flint hand-axes of paleolithic man, and realizing the skill with which they were made, are prepared to believe that such highly-developed specimens represent the first efforts of an intelligent being to shape stone intentionally. The truth of this supposition was borne in upon me many years ago, and, in consequence, I set about searching for flint implements which could be regarded as the ancestral forms from which the hand-axes were developed.

At that time I had already carried out extensive researches in the bone bed, (Figure 1,) beneath the Red Crag of East Anglia, in the eastern part of England, and had recovered from this deposit a series of implements of definitely human origin, and referable to the remote Pliocene epoch. The most

they were made, and this work revealed a very interesting and significant series of facts.

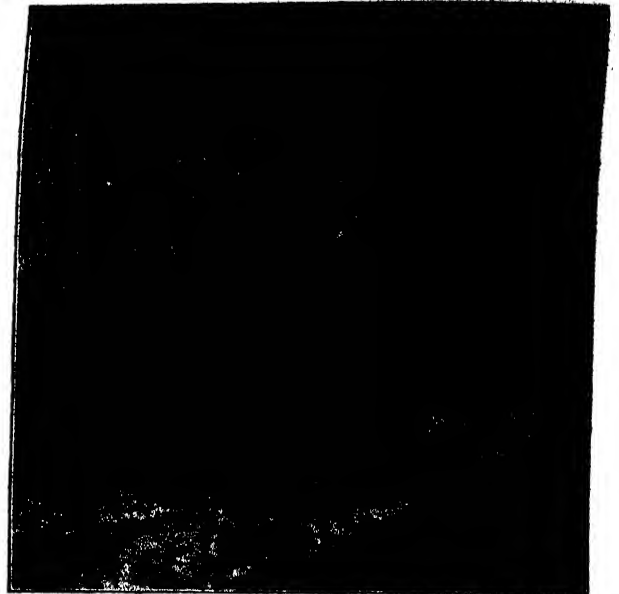
The earliest known implements of man are the eoliths which are formed almost exclusively from pieces of tabular flint which have been roughly flaked along one or other of their edges (Figure 3). In the days when these specimens were made there were available upon the land surface large quantities of tabular flint which possessed two naturally-produced and more or less flat striking platforms upon which the people of the Dawn Age could deliver blows with their hammerstones, and detach the discord flakes.

It is somewhat difficult to imagine how these first representatives of the human race could ever have started making stone implements, but for the kindly provision by Providence of such easily-flaked material as tabular flint. However, the inventive genius of man, which is apparent even in Eolithic times, would probably have produced implements of some kind, even if tabular flint had not been available. It is not too much to say, however, that if this material had been absent the evolution of flint implements would have taken a different course from that which it followed, resulting in the development of implemental forms differing widely from those with which we are familiar. If a pointed eolith (Figure 3) is examined in profile it is seen that, in the majority of cases, a beak-like form is observable. The production of this form is, however, almost inevitable in making an Eolithic implement of pointed type, as may readily be proved by experiment.

When the first stage of man's evolutionary progress in implement-making had passed, we enter upon the next stage which is represented by the artifacts

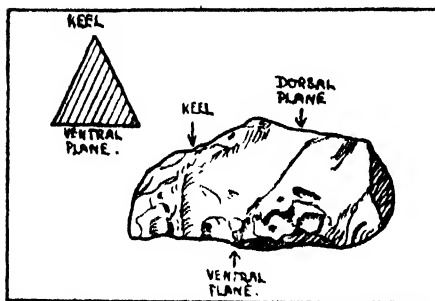
found in the bone bed beneath the Red Crag of East Anglia. When the people of these far-distant days arrived upon the ancient land surface of East Anglia they found that the flint at hand was in the form of rounded nodules, quite different from the tabular variety. We can imagine that these nodules were gravely examined by the new arrivals, and that attempts were made to detach flakes by delivering blows upon the rounded surfaces of the flints. The uselessness of these attempts would soon be made manifest, and the conclusion would be arrived at that some other method of attack was needful.

It was then that the knowledge acquired in Eolithic times came to their aid, and enabled them to see that by some means the intractable nodular flints had to be altered to a tabular form. In the last issue of this journal I have shown how this alteration was brought about, and it is therefore sufficient to say that the rounded stones were fractured by two cleaving blows by means of which a tabular piece of flint was produced. When this was accomplished, blows were delivered upon one of the flattish surfaces in the same way in which the Eolithic implements of pointed form were made, except that in the case of the pre-Crag specimens, the tabular flint, being of



BONE BED BENEATH THE RED CRAG

Figure 1: The author is pointing to the bone bed in which many implements of the rostro-carinate type were found

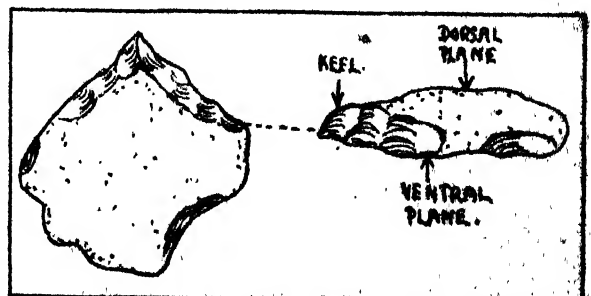


A ROSTRO-CARINATE

Figure 2: Even before Pleistocene time, probably 1,000,000 years ago, this peculiar type of implement had already been evolved

outstanding type of these pre-Crag specimens is one which has usually the unflaked flint cortex at one end where it was no doubt held in the hand, while the other is carefully trimmed to the shape of the beak of a bird of prey (Figure 2). These are the rostro-carinate implements which represent a new and hitherto unrecognized form of the handiwork of ancient man.

Now when these specimens were discovered I decided to ascertain, by making an examination of their flakings, exactly how and on what plan

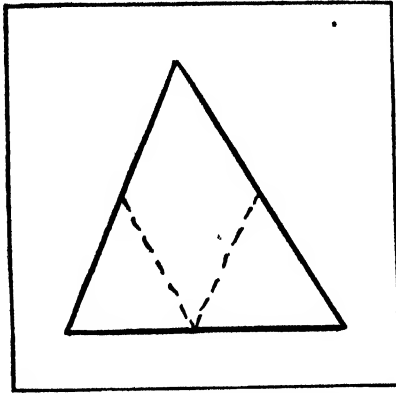


AN EOLITH

Figure 3: Most ancient are the eoliths which blend into the dimness of Tertiary times, over a million years ago

greater thickness, a large and more imposing artifact resulted.

In the rostro-carinate (Figure 2) most of one of the flat surfaces originally produced is preserved and is called the lower or ventral plane, while the other flat surface (the upper or dorsal plane) is considerably reduced in size in the formation of the pointed end and "keel" of the specimen. Now,



ANOTHER STEP FORWARD

Figure 4: How the rostro-carinate type was converted to later type; a cross-section

at first sight a rostro-carinate, of which a section taken through the functional portion is triangular, seems to bear no resemblance to a pointed or oval implement of lower Paleolithic age, which is generally of a rhomboidal section (Figure 4).

But fortunately there are preserved in certain collections, examples of the earliest Chellean hand-axes, and an examination I carried out of these soon showed me that some, when viewed in profile, with the pointed end held to the right or the left as the case may be, exhibit a definite beak-like appearance (Figure 5). Further, sev-

eral of these specimens possess only one cutting edge, the other being represented by a flattish surface, while in the case of the side with a cutting edge there is often preserved a part of a similar surface (Figure 5).

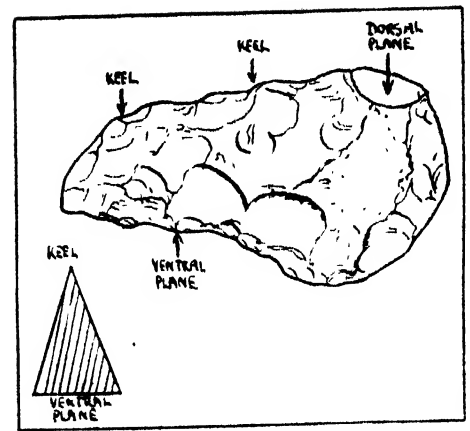
These flat areas had been recognized by archeologists for some years, and described as "lateral platforms," which is a correct term when the specimen is viewed in the normal manner with the point uppermost. But the true significance of these platforms was not understood. Now, however, we recognize them to be the remains of the original striking platforms produced in the initial shaping of the nodule of flint, and precisely similar to those forms in the first stages of the manufacture of a rostro-carinate.

FROM the evidence of the various specimens of early Paleolithic implements now available for examination, it is clear that the keel of the rostro-carinate was gradually extended backwards until it extended from one end of the implement to the other, and gave to the tool the form of a chopper. When this was accomplished the specimen still retained its original triangular section, the base of the triangle representing the flattish surface held in the hand while the apex represented the cutting edge.

Apparently it was eventually realized by the ancient people that it would be an advantage if a cutting edge opposite to the keel could be produced, and after many attempts this was carried out by flaking away either side of the flat ventral plane (Figure 4). Thus the transition from a rostro-carinate with a triangular section to an early Chellean hand-axe with a rhomboidal section was accomplished by the com-

pression, as it were, of the former until the new type of implement was produced (Figure 6).

Strange to say the type of paleolithic implement with triangular section of very low elevation which was formed by the depression of the rostro-carinate follows the plan upon which the fish known as the skate was evolved from ancestral squaloid form (Figure 6B). It is not of course to be supposed that the ancient flint flakers knew anything about the manner in which these fishes were developed, but nevertheless the facts above described are of con-



EARMARKS OF TRANSITION

Figure 5: Often these bear evidence of the evolution suggested by Figure 4.

siderable interest and possible importance.

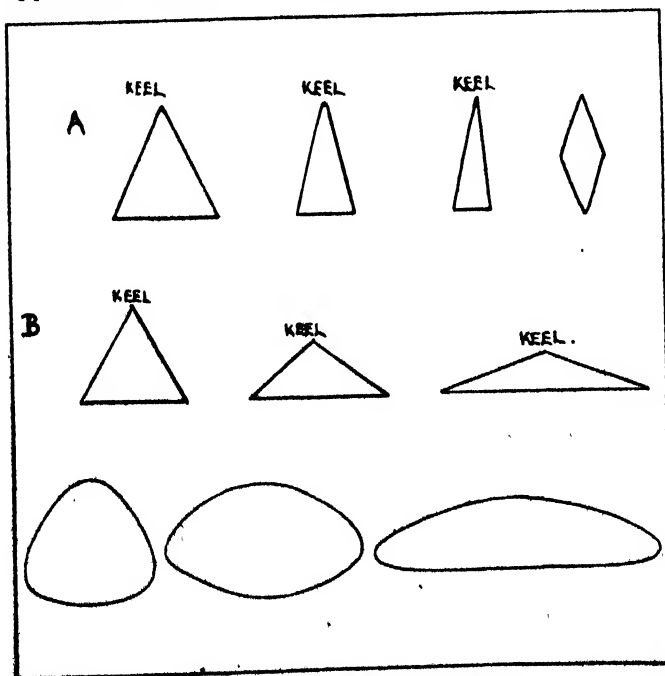
In the paleoliths with a triangular section of low elevation the keel of the rostro-carinate had ceased to be a functional part of the implement, and these specimens thus differ markedly from those with a rhomboidal section—although the completed weapons could be put to precisely similar purposes.

FROM the above considerations it is obvious that the primitive eolith was developed into the rostro-carinate, while the latter gradually "evolved" into the well-known implements of Paleolithic type. The Eolith specimens thus take their place at the very base of the implemental series and must therefore be regarded as having played a fundamentally important part in the development of human industries in pre-historic times.

Further, throughout all the various stages of flint implement making, Eolith forms are occasionally found, as are the rostro-carinates; and I have in my possession examples of these primitive types found in deposits referable to the very end of the Stone Age.

There is no doubt that any implement which survived and was used over a period of at least 500,000 years must have been of great importance to pre-historic man. After many years experience and intensive assimilation of flint implements of all ages I have reached the definite conclusion that every ancient industry is indissolubly linked to that which goes before and to that which follows after it, and that all can be traced back in an unbroken line through the rostro-carinate implements to the primitive and simple eoliths which represent, so far as we at present know, man's first mechanical achievement.

This completes the series of three articles on flint flaking. Readers are requested to send the editor samples of their efforts to reproduce the ancestral skill.



THE COMPLETE EVOLUTION

Figure 6: The lower figures, by the American Museum of Natural History, are sections of a spring dog fish, monk fish and skate



A NEW FARM PRODUCT

The fur of muskrats, now raised on farms, is much sought after for use in so-called "Hudson seal" and other coats

IT is not long since the muskrat in Canada was regarded as a very insignificant member of the country's fur-bearing fauna. His value was almost too trivial for the northern trappers to bother with him, unless the pelts could be secured in large numbers without any great effort. Farm boys used to make good use of their spare time by trapping or shooting muskrats along streams or the edge of sloughs in the neighborhood of their homes and then taking the pelts to town on Saturdays to be traded in at the general store for a handful of candy. Times have changed. Today the same unprepossessing little rodent is occupying the attention of brainy men with capital and initiative, and the stretches of swamp and marsh, heedlessly passed over in the years of agricultural settlement as utterly unfit for any practical purpose, have taken on a high value as suited to the domestic rearing of muskrats.

ONE of the outstanding and most interesting features of post-war development in Canada has been the expansion and branching out of the Dominion's fur-farming industry. The vast amount of valuable information acquired in the gradual evolution of the fox-farming industry, which has spread from Prince Edward Island into every part of Canada, and from the Dominion into nearly every country of the globe, has been applied with most gratifying success to the domestic rearing of other fur-bearing animals whose pelts are in continual demand, both indigenous and exotic. Each year new ramifications have been added to the fur-farming industry until it now includes, in addition to foxes of all kinds, raccoon, mink, skunk, marten, fisher, lynx, beaver, coyote, Siberian hare, Chinchilla rabbit, and Karakul sheep.

The Canadian Government, which first took official cognizance of the fur-farming industry of the country in 1919, has been able, in a fairly accurate manner, to keep track of and record the progress of all branches of this new activity with the exception of muskrat ranching. Owing to the manner in

securing of statistics has been found impossible since operators themselves have but the vaguest of ideas as to the extent of their possessions. This is one reason why the astonishing growth which has taken place in muskrat ranching in Canada has not received the attention it warrants and why the significance of certain developments in western Canada at the present time are not properly appreciated.

From the earliest days when men were attracted to the forbidding land fabled to contain rich peltry, the humble little muskrat has played an outstanding part in the country's fur trade. Down through the years when Canada was considered little else but a large fur depository, and later through the stages of agricultural settlement, it has been trapped in hundreds of thousands annually. While the beaver may have accounted for the greatest revenue, his humble relative has contributed the numbers. Records of the Hudson's Bay Company show that in 1850, 175,000 Canadian muskrat skins were sold in London; in 1860, 250,000; in 1870, approximately the same figure; and by 1902, 1,650,000.

Muskrats to Order

The Fur of These Once Lowly Rodents Now Forms the Basis of Profitable Farming Projects

By E. L. CHICANOT

which establishments devoted to the raising of this animal are operated, approximating the natural, primitive condition, the

Government figures show that in the season 1922-23 nearly 4,000,000 muskrat pelts were taken in Canada; in 1923-24, 3,000,000; and in 1924-25 over 2,500,000.

Quite meteorically this ubiquitous and plebeian little rodent has made an ascendancy into the ranks of the aristocracy. From the most insignificantly regarded of the country's fauna he has come to be one of the most appreciated and valued by trappers, traders, and manufacturers alike. The initial ambitious step was made in the concluding years of the first decade of the century when this lowly slough-dweller began to achieve a marked popularity under the pseudonym of Hudson seal. Gradually it came to take on many other aliases, and the security of the future of the muskrat industry is held to be the readiness with which the pelt of the little animal can be adapted to imitate the rarer and more valuable peltry.

THERE has naturally been a corresponding rise in the revenue accruing from the sale of muskrat pelts. In 1850 Canadian muskrat skins sold in London for eight cents apiece, and in 1860 for 19 cents. By 1903 the price jumped to 22 cents, and in 1910, when the upstart ambitions of the humble-born rodent were first evidencing themselves, pelts brought an aver-



DOWN ON THE FARM

A pair of contented muskrats on the edge of a pool on the marshy land which is their farm home in Nova Scotia. Their pelts will soon be part of a "Hudson seal" or other fancifully named coat

age of 87 cents. From then on the muskrat continued to realize good prices until in 1919-20, a year of extraordinary values in all lines, the spectacular figure of \$10.50 was reached at the New York fur sales. Prices have now become fairly stabilized under steady demand and there is every likelihood of their remaining so. The Canadian catch of 1922-23 returned an average of \$1.32 per pelt to the primary producer; that of 1923-24 \$1.15; and that of 1924-25 \$1.11. At the Montreal fur sales in 1925 muskrat pelts sold up to two dollars and in 1926 and 1927 ranged from \$1.50 up to two dollars, prime ranch-bred skins bringing a slightly higher figure.

THE rising value of peltry, in combination with the devotion of interest to the matter of expanding the fur-farming industry, resulted in some attention being given in parts of Canada to the possibilities of raising muskrats domestically, which it seems almost strange now should not have come earlier. Immediately there was inaugurated an industry of such tremendous possibilities, with so many advantages and such opportunities for profit, and withal so few apparent handicaps, as to cause conservative individuals to hesitate at the very rosiness of the prospect. And, according to the best authorities, conditions are exactly what they appear to be. Domestic muskrat rearing they declare to entail little labor, to be remunerative, and at the same time to be practically fool proof. While Canada has no monopoly of the industry, which is to be found flourishing in many parts of the United States, it promises to attain heights of development in the Dominion which no other country can reach because none other possesses all the requisites to such a degree.

While experiments in raising musk-

rats without water, in small pens, on dry land, after the intensive manner of foxes and other valuable fur-bearers, have been successful, without injury to the fur or the health of the animal, and without impairing the prolific breeding qualities of the animal, such methods would appear to be objectless and impracticable, and have received little attention. With the relatively low value of the individual pelt, the essence of muskrat ranching is production on a large scale, and Canada is dotted in every section of her wide expanse with pieces of waste, unproductive swamp and marshland, the natural home and breeding ground of the little rodent.

To transform such a piece of swamp into a muskrat farm is the easiest thing imaginable, and when effected on a large enough scale the animals scarcely realize they are being confined or "farmed." All that is required is a rat-proof fence put around the entire acreage and sunk to a depth of about eight inches in the ground. This is not so much to keep the rodents from wandering too far as to prevent the coyote and fisher, the natural and almost only enemies of the muskrat, from getting in.

SUCH a piece of land in Canada will almost invariably be found to contain the nucleus of the future rat population and continual stocking may be effected from neighboring creeks and sloughs to supplement the foundation colony. Muskrats can be caught in box traps at any time of the year, and the extent of operations is only limited by the area fenced.

Thereafter there is not a great deal to do but watch the animals multiply and take toll of the increase in the winter. The muskrat is extremely prolific, with from three to five litters per year, and a pair of animals will produce as many as 50 young in a

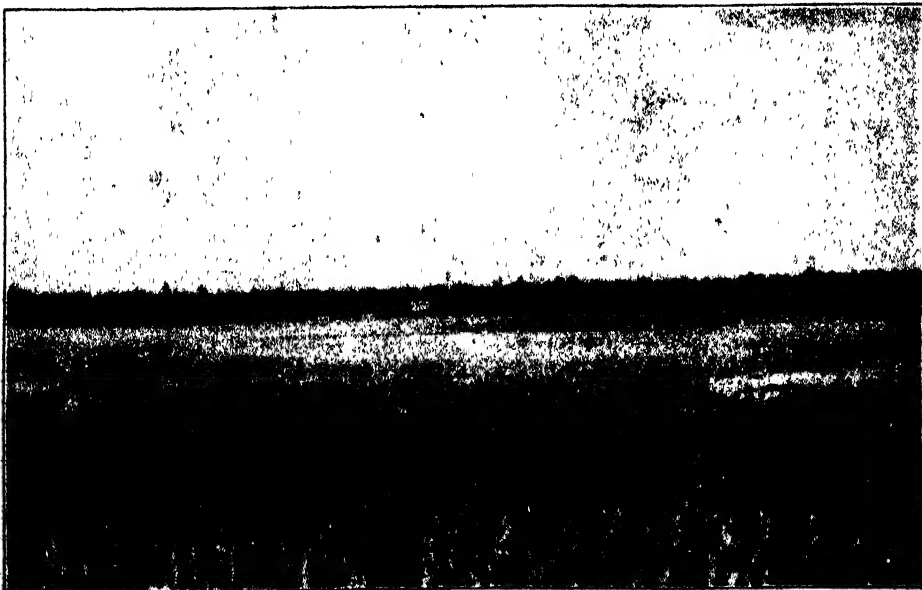


A FUR FARMER

This successful muskrat farmer made a profit of 10,000 dollars for a year's catch

season. A 500 percent increase in a ranch's population in a year is a very conservative estimate. Muskrats are signally immune from disease, and the greater part of their sustenance is naturally provided both winter and summer. A shortage of natural food in the winter months is met by vegetables thrown through a hole in the ice, the icy water keeping the vegetables indefinitely. The economy of feeding may be gathered from the fact that a bushel of turnips or mangels will feed a muskrat from 10 to 12 weeks.

IT is little wonder that such numbers of people in all parts of the world have been investigating the possibilities of the muskrat industry in Canada. It is considered that the time may come when the domestic raising of this little rodent will generally be added to the many phases of mixed farming followed in Canada, and agriculturists utilize pieces of unproductive swamp land on their holdings to develop a profitable side line, as is becoming an increasing practice with foxes, to supplement farm revenue. There are already a great many farmers in all parts of the Dominion raising muskrats on small sections, although the present conception of muskrat ranching is an elaborate enterprise involving a substantial acreage and the production of the animals by the thousands each year. For this purpose large sections of what was previously considered waste land are being taken up and the development of a gigantic industry is forecast, particularly in the western part of the Dominion of Canada.



A TYPICAL MUSKRAT MARSH

This is the kind of land which is ideal for muskrat farming. Low, marshy, it is of little or no value for other purposes, but is ideal for raising the valuable rodents as it is their natural haunt

The present extent of the muskrat industry in Canada is only vaguely known, although it is followed in every



THE FENCE

A wire fence keeps the rats in, and excludes their enemies, the coyote and the fisher

province, for establishment on the part of Canadians, Americans, and the nationals of other countries has been taking place quietly and unheralded. The elaborate movement under way, particularly in the western provinces, is only publicly indicated when some very large enterprise is launched. It only became known that the governments of the Prairie Provinces had been deluged with applications to file upon marshlands in the territory when the provincial authorities together approached the Dominion Government with a view to securing the transfer of the control of such lands to them. Shortly after this, Manitoba set about an official scientific survey of lands, food supply, et cetera, in its northern territory which possesses some of the largest marshes on the continent and put the airplane to novel use in sowing wild rice over these lands in order to extend the feeding grounds and natural habitat of the muskrat.

IN the last great pioneering territory of the Peace River country of northern Alberta, where many stretches of land suitable for muskrat ranching exist, there has been quite an invasion with this objective. Not long ago a syndicate acquired 15 quarter sections, or a total of 2400 acres, upon which there were thriving muskrat colonies, and transformed it, by fencing, into a gigantic muskrat preserve. Eastern capitalists secured 1000 acres of swamp at Oak Lake, Manitoba, for a similar project and the fencing of the property alone cost 20,000 dollars. A Milwaukee cattle rancher, establishing a large Hereford ranch in Manitoba, purchased an adjoining 640 acres of swamp, stocked it with muskrats, and formed a syndicate to operate it.

Yet greater interest and activity has been apparent in British Columbia, where the muskrat, domestically reared,

supplementing the raw catch, reaching the market as Hudson seal, has almost in point of value come to take the place of the great annual catch of seal skins in the North Pacific which constituted such an important item of British Columbia revenue in the past and was brought to an end some years ago by international treaty. The growth of the industry there is by no means solely attributable to residents of the province but to many newcomers from Washington, Oregon, and other Pacific coast states.

In this province the Columbia-Kootenay valley has come very much to the fore in the muskrat industry. The confluence of two great rivers, it possesses tremendous areas of overflowed marshlands, the haunts of muskrats, and these have been fenced off and occupied with a rapidity which forecasts a great local industry. Not only have old residents of the valley turned to this new activity but last year ranches of over 1000 acres in ex-



A MUSKRAT HOME

Composed of mud and sticks, the rodents' homes dot the swamp of the muskrat farm

tent were established by men who had come from Washington and Oregon for the purpose.

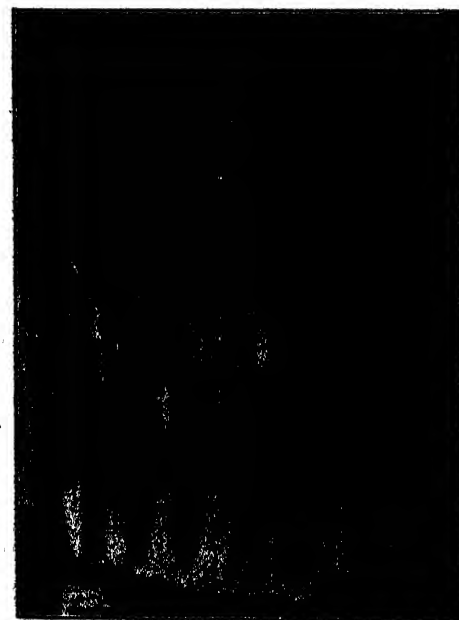
The same is taking place in other sections of British Columbia's interior where large areas of such suitable land are frequently to be found, and men who have been following the arduous trap line for years are coming to settle down to an equally profitable living under the more comfortable conditions of intensive farms. The biggest muskrat ranch in Canada, which probably means the entire world, was established not long ago at Swan Lake, about 40 miles west of Quesnel, in central British Columbia. It consists of an area of swampland, lake and woods, totalling over 8000 acres. Some idea of the extent of operations may be gathered from the fact that weekly disbursements to trappers for foundation stock ran to a thousand dollars, and it is calculated that the ranch, when in full swing, will have an annual output of about 50,000 pelts.

The greatest development in musk-

rat farming in western Canada is yet to come. The petition of the Prairie Provinces to the Dominion Government was granted and they have secured control of their swamplands to be leased for the purpose of following this activity. Leases are ordinarily not to exceed 640 acres, although larger leases may be secured if conditions are such as to warrant granting them. A yearly rental of 25 cents per acre is to be charged for the first three years, thereafter one dollar per acre. Trapping of muskrats will not be permitted during the first year of any lease except under special permit. Awaiting the coming into force of these regulations are over 200 applications in Alberta, over 500 in Saskatchewan, and over 250 in Manitoba. The present year should see the real dawning of the muskrat era in western Canada.

MUSKRAT farming in western Canada, there is every indication, is going to be a great industry. It is a phase of the broad and growing industry of fur farming which has just been initiated and already gives definite promise of outstripping other branches of domestic fur production in popularity and possibly in revenue. It is an industry which has a particularly strong appeal for the uninitiated contemplating engagement in fur farming, since in it expert and novice have practically equal chances, and this is going to be a factor in swelling the army of followers. It is of peculiar value and outstanding benefit to the country as utilizing and rendering revenue-producing such spaces as are at present unproductive and considered worthless.

Zane Grey, well-known author and sportsman, has prepared a thrilling story of big game fishing in the South Seas which will appear shortly.



MUSKRAT WAREHOUSE

After removal, the rat pelts are stretched on special wire forms and hung up to dry

How Old Are The Everlasting Hills?

Dating the Geologic Age of Mountain Ranges Involves a Careful Investigation of Many Kinds of Evidence

By EDWARD W. BERRY

Professor of Paleontology, Johns Hopkins University; Geologist, United States Geological Survey; Assistant State Geologist, Maryland; Member, National Academy of Sciences; American Philosophical Society

MOUNTAINS, like shore lines, seem to be the permanent features of geography, and doubtless from the standpoint of marking political boundaries they are most admirable. But from the standpoint of geology both are temporary features of the autobiography of the earth.

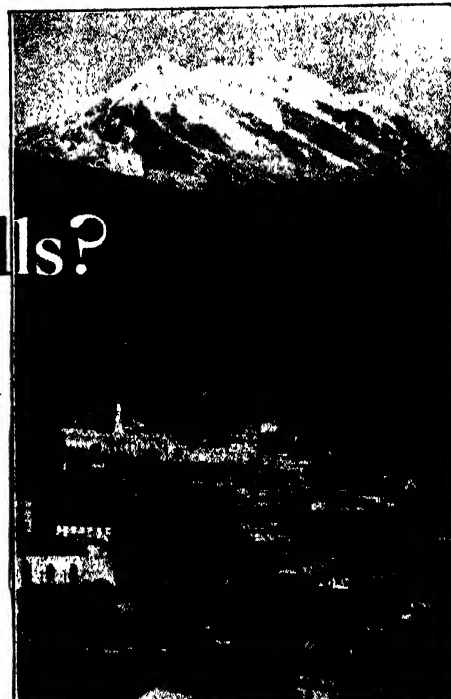
Mountains were the very last features in man's environment to be humanized, as it were. We can only surmise what early man thought, but judging from the reactions of present-day, backward or savage races such as the Andean Indian, the mountains were the abode of spirits—mostly hostile, as suggested by the inhospitality and terrors of the high peaks.

We get the same impression from Greek mythology or from a perusal of English poetical or prose writings to the end of the 18th Century. Mountain scenery was to be viewed from a distance. The high regions of the earth, rugged, desolate, and dangerous, were not to be trifled with nor entered lightly, nor traversed save under direst necessity. This, as I have hinted, was due largely to the unconscious survival of notions inherited from earlier days when the mountains were the abode of evil spirits, and was not a mere prejudice, as Geikie calls it.

AMONG the host of mountain climbers that annually go to the Alps, the Rockies or the less lofty White Mountains, or those that brave the Canadian Rockies, Andes or Himalayas, how few are aware that these majestic features of the earth's surface are so youthful, or that even the Alps—that great playground of mountaineering, which has in recent years been the inspiration of an entirely new school of mountain structures—was scientifically unknown until first studied by the geologist de Saussure, born in Geneva as late as 1740?

The geologic history of mountains

may be said to have been inaugurated by elongated depressions in the earth's crust sufficient to permit the flooding of the region by oceanic waters. Then, through long ages sediments accumulated in these geosynclines, as they are technically termed. With the gradual sinking of their foundations these sediments—mostly sandstones, mudstones and limestones—piled up thicknesses of many thousands of feet. At intervals these sedimentary beds were folded by compressive crustal forces. It was formerly supposed that this folding of the rocks resulted in their elevation, but this is now known in many instances to be a false assumption, for the elevation to great heights usually occurs ages after the rocks were folded, and is due to gravitational readjust-



ILLIMANI AND LA PAZ

This great mass, 21,204 feet in altitude, consists largely of Tertiary granite laid bare by erosion in the uplift of the eastern Andes

ments, the folded sediments being of less density than the enclosing plutonic basin.

Elevation alone would scarcely develop mountains as we know them, but rather plateaus, and it requires the long continued action of the weather—snow, rain, frost, and so on, to remove the more soluble and less resistant portions and etch the relief of peaks, valleys and crags that are the distinctive features and charms of all mountain ranges.

It may be said then that, granting the appropriate antecedent history as outlined above, the two immediate factors concerned with mountain building are elevation and subsequent erosion. A surpassingly interesting problem is that of dating the elevation.

WE know that all of the great mountain ranges of the present were elevated in comparatively recent geological times, since long continued erosion finally reduces the inequalities of the topography and wears them down to their roots, like the present Piedmont country which forms the inland border of the Atlantic Coastal Plain.

It is comparatively easy to date the time of the folding of the sedimentary rocks by the fossils which they contain, but this is not to be confused with the period of uplift, and the last is much more difficult, largely because it is comparatively rare to find marine fossils after uplift commences. If we find, as is the case, marine fossils of Pliocene age at heights of a mile in the southern Andes, we know of a certainty that there has been an elevation of over 5000 feet since the time they lived.

ERAS	PERIODS	TIME IN ALL AGES (Barrell)	CHARACTERISTIC LIFE
PSYCHOZOIC	Recent	1	AGE OF MAN
	Pleistocene	1	
	Pliocene	7	
CENOZOIC	Miocene	19	AGE OF MAMMALS AND MODERN FLOWERING PLANTS
	Oligocene	36	
	Eocene	55	
	Cretaceous	95	
MESOZOIC	Comanchian	130	AGE OF REPTILES
	Jurassic	155	
	Triassic	180	
	Permian	215	AGE OF AMPHIBIANS AND ANCIENT FISHES
PALÆOZOIC	Pennsylvanian	250	
	Mississippian	300	
	Devonian	350	
	Silurian	400	
	Ordovician	450	
PROTEROZOIC	Cambrian	550	AGE OF HIGHER SHELLED INVERTEBRATES
	Systematic classification variable	925	AGE OF PRIMITIVE INVERTEBRATES
ARCHÆOZOIC		1500	LONG EROSIONAL INTERVAL
			DAWN OF UNICELLULAR LIFE, ALGAL FUNGUS REPORTED

Courtesy of Field Museum

BARRELL'S TIME ESTIMATES

The durations are based on radio-active changes in rocks of the several time periods

But elevation does not proceed at a rate that can be called rapid from the human point of view, and hence the rising mountain area will usually have been above sea level for many thou-

We can conclude, then, that in late Miocene time this mountain chain was not yet sufficiently elevated to have brought about the extinction of the Miocene flora; but at what altitude that flora lived, or what the amount of post-Miocene elevation was, we have no means of determining at present.

A mountain system which has long attracted my attention as likely to throw light on our problem is the Andes. They are unique among the great systems of the earth in that they are now excessively and continuously high; they overhang a coast, and what is more to the point, they run approximately north and south, well across the equatorial and southtemperate zones, and consequently intersect the two most

where it may not normally rain at all for years at a stretch. Correspondingly, on the east side of the Andes from southern Bolivia to the Straits of Magellan is the rain shadow formed by the Andes in the path of the westerly winds, and a resulting practically treeless steppe and pampas country.

Obviously these present climatic and vegetational contrasts on the opposite sides of the Andes throughout so much of their extent were brought about by the elevation of the mountain mass, and these changes are rather clear cut and typical, although by no means as simple and devoid of local complexities and perplexities as I have sought to present them. It follows, then, that we have, in the Andean segment of South America, a region, if anywhere on the earth, where terrestrial fossils will help us solve the date and measure of uplift.

FORTUNATELY, fossil plants of Tertiary age are by no means rare and I have been engaged in the exciting pastime of hunting them down and studying them for many years. To date I know over a score of widely scattered localities ranging all the way from the shores of the Caribbean to Terra del Fuego, and many are most strategically situated. Some are in the Peruvian desert, others in the eastern foothills of the Peruvian Andes. A number are in Bolivia in the western Andes, on the high plateau and in the



GREAT SNOW MOUNTAIN

Here, in the Quimsa Cruz range of Bolivia, the author collected marine fossils in rocks thrust up above 16,000 feet in altitude

sands of years before it reaches its maximum height. The sedimentary rocks that are formed during this period of uplift will be volcanic ash, lake and stream deposits and will doubtless contain some traces of the contemporaneous terrestrial animals and plants. But in most cases, although we can tell the age of these fossil terrestrial organisms with even more precision than we can tell the age of fossil marine organisms, we cannot tell the altitude at which they lived, and hence have no measure of the amount the beds containing their remains have been elevated since they were entombed.

An illustration will make clear what I am trying to explain. At many points in the Great Basin of the western United States we find ash beds or clays and diatomaceous beds containing leaves and other traces of the contemporaneous vegetation. A notable locality of this sort is around Spokane in eastern Washington, and there are others in Idaho and Nevada. These fossil plants are like those found today in the mesophytic hardwood forests of the eastern United States and those of eastern Asia—such things as sassafras, tulip trees, gums, walnuts and magnolias.

WE know that they could not exist in the present more or less arid environment of the Great Basin. We know that during the Miocene age when they flourished, the climate was more humid than it is today in that region, and we know also that the main factor in bringing about the present day aridity was the elevation of the Sierra Nevada and other ranges.

constant wind systems of our planet—the easterly trades throughout their northern extent, and the westerly “roaring forties” throughout their southern extent, and both of these wind systems are better developed and more constant in the Southern Hemisphere than their counterparts in the Northern Hemisphere, since in the north the great extent of the continents seriously modifies and impairs their steadiness.

THE south temperate westerlies compose the strongest, deepest, and most constant wind system of the globe, and the southern trades come next. Ignoring the other factors, the rearing of the bulk of the Andes across the paths of these winds has resulted in profound climatic changes and equally profound changes in the character of the animal and plant inhabitants of the region. The eastern slopes of the Andes from southeastern Colombia through Ecuador and Peru to central Bolivia are among the wettest regions of the earth and are covered with a tangle of tropical verdure. The western slopes of the Andes from central Chile southward become progressively wetter until in the region around and south of Valdivia, Chile, we encounter another region of excessive rainfall and consequent equable temperature, resulting in a temperate rain forest rivaling that of the wet tropics.

A comparatively few miles across the mountains and the picture is entirely changed. From the Gulf of Guayaquil in Ecuador to Coquimbo in Chile, a distance of over 2000 miles, the west coast is desert and there are long distances



MOUNT CACA ACA

Caca Aca, in Bolivia, is 20,571 feet in altitude. Here also, the author collected marine fossils above the 16,000 foot level

eastern Andes. Others are in the present wet coastal region of Chile and east of the mountains in Patagonia. Thus they not only prove that the equatorial trades and the temperate westerly winds were operative in the late Tertiary just as they are at the present time, but they furnish the most precise data that we have for estimating the rate and amount of uplift since Pliocene time.

The detailed technical evidence would not interest the reader, but it may be said that one finds in the Peruvian desert the fossil remains of a wet tropical forest whose relatives are found today east of the Peruvian Andes. Similarly, in Patagonia one encounters fossil plants like those "found fossil" across the mountains in the south Chilean coal fields and whose near relatives occur at present in the Argentine mesopotamia or in the humid country in southwestern Brazil.

ON the famous peak of Potosi in Bolivia, in the volcanic ash deposits of a tiny Pliocene lake at a present altitude of about 13,000 feet, the fossil plants are those of a low country. On the bleak and treeless Bolivian plateau at elevations of 11,000 to 13,000 feet one encounters the leaves of lowland species and the petrified tree trunks of such woods as the Lauraceae and Leguminosae with no traces of seasonal rings, such as one finds today in only low and well watered warm regions. In the mountains near Cochabamba, Bolivia, and similarly near Celendin, Peru, are fossil plants of tropical rain forest types such as are found today only at altitudes from 3000 to 6000 feet lower and east of the mountains.

All of the facts thus far discovered consistently point to the same conclusions. We have the fossil seeds of bananas and other tropical fruits at altitudes much greater than they reach

which I estimated were from 6500 to 8500 feet below their present altitude.

No more dramatic or dynamic picture can be imagined than the final uplift of this majestic mountain system across the equatorial zone at the close of the Tertiary; and that this took place in comparatively recent times, geologically speaking, is shown by various collateral lines of evidence. Naturally, in the bordering country from Ecuador southward to Cape Horn where this uplift resulted in heavy rains on one side and relative to extreme aridity on the other, no comparisons of the existing faunas or floras on two sides can furnish much evidence. But in regions like the Choco country of western Colombia where wet tropical conditions continued uninterruptedly we find today many species of birds and fresh water fishes that have been isolated from their fellows of the upper Amazon and upper Orinoco country for a time too short to have them show any great differences; so that frequently you will find the same species, or at best merely a subspecies, dwelling in the coastal region of Colombia or northern Ecuador and separated from their kin of the country east of the Andes by hundreds of miles of mountain country with temperate, or at extreme heights, of boreal forms of life.

THE fossil remains of warm blooded animals in the late Tertiary deposits of the Andes tell the same tale as the fossil plants, although the details are not so well known. Still we know that at the time the plants that I have been speaking about were flourishing, the present mountain country was inhabited by large herbivorous mammals such as the mastodon, horse, and gigantic ground sloths. These would speedily starve to death if they could be re-introduced into the country over which they once roamed when it was at a lower altitude. Some of the elevations where these fossil mammals have been found may be of interest. Thus, La Casa del Diablo in Peru is 12,400 feet, Ayusabamba, Peru, is slightly higher, and a locality near Cerro de Pasco, Peru, is 13,000 feet, as is Ulloma, Bolivia.

Other corroborative lines of evidence of the recency of the last and major elevation of the Andean system are drawn from the uplifted marine terraces of Pleistocene age, especially well de-

veloped in Chile and northern Peru. Other data are derived from the evidence of tilting of old land surfaces once approximately horizontal (peneplains), or from a study of drainage profiles.



YIELDED FIVE BILLIONS

Cerro Rico de Potosi (15,381 feet) has yielded 5,000,000,000 dollars in silver. High up on its flanks are lowland plant fossils

Still other and more impressive are the maturely eroded upper slopes of the high mountains.

A PHYSIOGRAPHER, if he were put down in the midst of the mountains, would imagine from the waste-covered gentle slopes and the abundance of undrained punos or paramos, that he was a few hundred, instead of 14,000 to 16,000 feet above sea level. The Andean country of the lower slopes and the stream patterns are youthful instead of mature, showing the results of the rejuvenation of the streams brought about by the last and greatest uplift of the region.

That the final elevation of the Andes was also the approximate time of uplift of all of the present mountain systems of the earth seems to be a safe generalization, since, as I remarked at the beginning of this article, if they had been raised to heights much earlier they would have been reduced to insignificance by now, through the action of weathering and erosion. We believe this dictum, but no system shows it as clearly and conclusively as do the Andes. The accompanying superb views of famous peaks might seem to belie my statement of the mature topography of the upland, but they, like many others that might be mentioned, projected so much above the general level that their grandeur has been increased rather than decreased by the very processes which produced the Tertiary base level, and the active erosion during the Pleistocene following their final elevation has stripped much of the blanket of sedimentary beds from their flanks.



HIGHEST PEAK IN PERU

Huascarán (22,051 feet). From a study of fossils of known age much may be deduced concerning mountain uplift

at the present time in the mountains bordering the sabana of Bogota on the east.

The fossils found at 11,800 feet in the present mountains of Cochabamba are especially impressive. Here, on a bleak and windswept pampa above the tree line, and clothed only with grasses, were found the relics of a rich tropical forest of palms, ferns, bananas, chirimoyas, and so on, which grew at heights



DR. GEORGE D. McLAUGHLIN

Dr. McLaughlin is director of the laboratory supported by the tanning industry

THE beautiful specimens of the leather worker's art that one sees in store windows bear little resemblance to the original raw material from which they were produced. Many interesting and almost mysterious things happen to leather between the time it leaves the animal as a hide and the moment a dealer puts the leather article on display.

Since the dawn of history, hides have been put through processes that convert them into what is essentially a different product. But even though these processes have been basically unchanged in a thousand years, men are still discovering new facts about what takes place. Recently, for example, the tanning industry has discovered exactly how it has been removing hair from hides all these centuries—and with the discovery it is preparing for industrial advances that will have their effect upon the shoes we wear, the luggage we carry and the leather we use in many other ways.

THE discovery, which has been made during recent scientific researches at a laboratory supported by the industry, has introduced a new factor in the production of the world's leather: methylamine. It now appears that methylamine, a product that results from the chemical action of lime on the hide epidermis, is the agent which actually releases hair from a hide. Having learned that, the tanner may now use methylamine in such a way that the important process of unhairing takes place in far less time than formerly. At the same time none of the benefits of lime action on the hide is lost. Fibers are not injured by the swifter depilation; the smooth silkiness of the grain surface is preserved; and all the advantages of the old process, in so far as quality of result is concerned, are retained.

There are few products of so perma-

nent and lasting a nature as leather that originate in a material so apt to decay as raw hides and skins. Disintegration and decay begin at the moment hides are taken off the animal carcass and it is necessary that these be promptly arrested, and the hide and skin substance preserved so that the tanner may receive his raw material in a good condition. Fortunately the preservative process most commonly used is a simple one and relatively cheap, permitting shipment of raw hides and skins to all parts of the world. For this purpose they are first washed with water to eliminate dirt and blood and are then immersed in a solution of common salt. Afterwards solid salt is sprinkled over the "flesh" side and the hides are piled evenly one over the other.

In many cases, especially in the United States, the practice is to confine the process merely to washing the hides and sprinkling the salt on the flesh side. The hides are allowed to remain in piles or "packs" for varying periods but not less than 30 days, during which they are said to be "in cure." The hides are then rolled or folded into bundles separately, tied with string, and are ready for the market.

Hides properly cured or preserved may be kept in cool storage for a long period but they must not be allowed to heat in pile. If this happens, damage may occur which seriously affects the value of the leather.

On arrival at the tannery, hides are

sorted for quality and weight and are inspected for butcher cuts which have an important bearing on the value of the hides. They are also examined for grubs—embryo parasites which are hatched and developed in the hides after the death of the animal.

The first step in the tanning process is to bring the hide back to its original condition by removing the salt or other curing material. This is accomplished by soaking the hides in fresh water and is usually facilitated by mechanical means. The hides are then ready for the depilatory which is usually a mixture of lime and water of about the consistency of milk.

JUST how lime came into use for this purpose is not known and history does not record it.

It is, however, an ideal depilatory. Because of its limited solubility, it can be used in large excess without injuring the fibrous structure of the hide. Lime, or calcium hydrate, is alkaline in its action and its function is to remove the hair and swell the fibers for the subsequent tanning process. At ordinary temperatures the liming process takes from five to seven days but the time can be shortened by employing mechanical action at slightly higher temperatures.

In recent years, alkaline sulfides mixed with calcium hydrate have come into general use to facilitate the depilation of the hide. Sodium sulfide is the material most frequently used, but because of its high solubility, care must



WHERE THE METHYLAMINES GET IN THEIR WORK

These huge liming tanks receive the hides after the salt used as a curing agent has been soaked out. The lime action loosens the hair, thanks to the intense activity of the busy methylamines

be taken in using it. Used in excess, it dissolves the commercially valuable hair. A great many new depilatories have been introduced from time to time but none have supplanted caustic lime for general use.

Until recent years, science had not given much attention to the problems of leather making and only within the past decade or two have chemists specialized in researches pertaining to leather manufacture. It is to the credit of the American leather industry that the first steps toward placing the industry on a scientific basis were taken by it. With funds contributed by the Tanners' Council of America, a modern, well-equipped laboratory was built at the University of Cincinnati under the direction of Professor George D. McLaughlin.

THIS laboratory, devoted exclusively to leather research, has functioned only a few years, yet has made remarkable progress in its attention to the fundamental problems of the tanning industry.

More than half of these problems are connected directly with the raw hide because the hide is the tanners' basic problem. The curing of hides by meat packers and butchers has received the closest attention and study by this laboratory with the result that the best means for curing hides for the preservation of the maximum leather forming substance has been demonstrated on a large commercial scale.

Following this accomplishment, the leather research laboratory under the guidance of Professor McLaughlin has devoted itself to the study of the action of lime on hides and skins and, after many months of painstaking effort, has finally arrived at what is believed to be the correct answer to the question: What causes the unhairing of hides and skins in a solution of milk of lime?



OFF COMES HAIR AND SURPLUS FLESH

After leaving the liming tanks the hides are put through a pair of scraping rolls such as are shown. The hair, loosened in the liming bath, is removed and the hides are ready for tanning

In the course of its study of this problem, the leather research laboratory discovered that when a lime solution had been used for unhairing a hide or skin, methylamine was always present in the residual lime solution. This suggested a clue to the really active agent in the depilation of the hides, and led to very careful experiments. In every instance, introduction of methylamine into fresh lime solutions resulted in the speedier loosening of the hair.

A FURTHER study of the subject showed that methylamine was produced by the action of lime solution on the keratin, the chemical name for the epidermis of the hide, and also on the horns, hoofs, claws, and hair. Methylamine is produced very slowly in the reaction between the hides and the lime solution and is frequently mistaken for ammonia because of the similarity of the odors.

Exhaustive tests carried on at the leather research laboratory prove conclusively that the unhairing action of

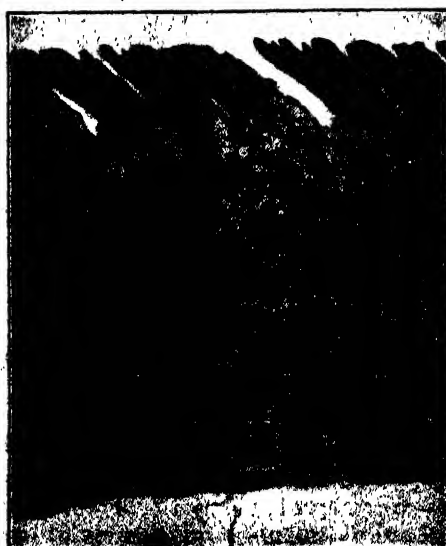
lime is caused by the production of methylamine in the solution; and that, by the addition of methylamine to a fresh lime solution, the time required to loosen the hair can be considerably shortened. Furthermore, the quantity of lime usually required for unhairing hides can be reduced measurably by the use of methylamine and, in consequence, the amount of waste lime sludge is reduced to a minimum. This is an important contribution to the problem of industrial waste disposal.

The work of the leather research laboratory of the Tanners' Council of America at the University of Cincinnati, Ohio, has fully justified the hope and expectations of those men in the leather industry whose vision and courage conceived it. In enlisting the services of science to solve their age-old problems, they have performed a notable public service because, without doubt, many new things will be learned about leather and tanning which will be reflected in a better quality of leather goods.



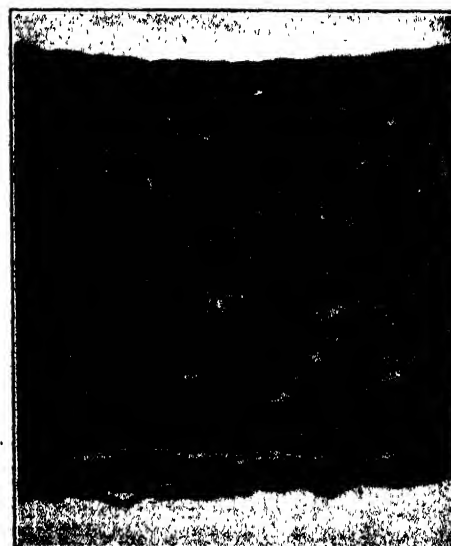
FRESH HIDE

Photomicrograph of a section of steer hide, showing the hair, hair pockets, et cetera



AFTER UNHAIRING

The action of the liming bath has loosened the hairs, and they have all been removed



FINISHED LEATHER

After the leather has been completely processed, a cross-section has this appearance



MICROSCOPE IS USED

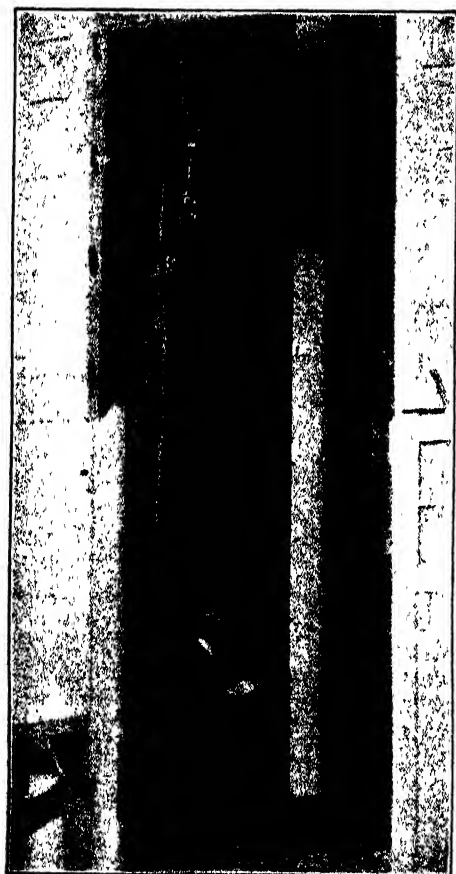
The microscope is used as the basis for the identification of wood rather than by an examination of the botanical characteristics of the tree

Where the Forest Meets the Laboratory



EXPERIMENTING WITH RAILROAD TIES

A truck load of railroad ties is being pushed into the treating cylinder in the course of the study of the technique of wood impregnation. The laboratory conducts tests for the many species of wood which are impregnated with preservatives



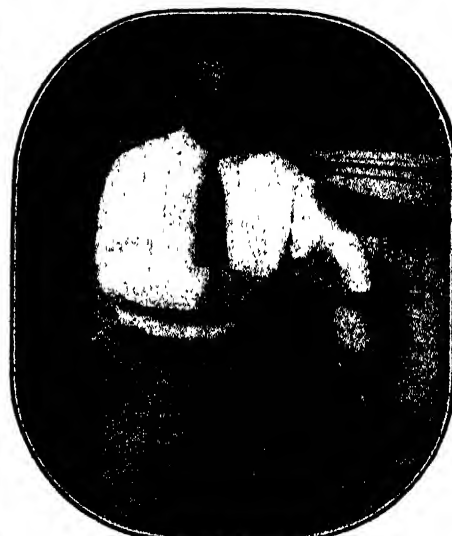
TESTING LONG COLUMNS

A timber 30 feet in length is readily accommodated in the capacious jaws of the great 1,000,000-pound testing machine. The same giant tests the strength of built-up beams, trusses and girders—to complete destruction



MOISTURE RESISTANCE

These panels, after being finished with various wood coatings, will be weighed and put into constant-humidity rooms to determine the moisture resistance of the coatings. Exposure tests in the open are also made



TESTING FIBER BOARD

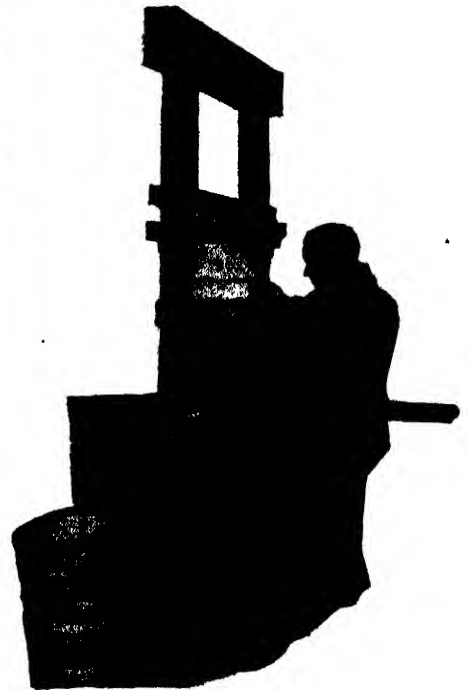
The inventor, Mr. T. A. Carlson, is operating a machine which subjects the board used for containers to repeated bendings and twistings so as to test the fiber's resistance. The scored board is being placed in the jaws

THE Forest Products Laboratory has the reputation of possessing great fascination from a scientific point of view, so one of our editors was sent to Madison, Wisconsin, a few months ago to collect photographs and get first hand information on this important governmental enterprise. The Forest Products Laboratory is a part of the research branch of the United States Forest Service. This laboratory—the first of its kind to be established—was started in 1910 for the study of the physical and mechanical properties of wood, its chemistry and pathology, and its manufacture, conversion, and use. Although the laboratory is housed in a building of the University of Wisconsin, it

is administered solely by the United States Forest Service and not as a university department. Naturally, because of the complexity of wood and because of its myriad uses, the Forest Products Laboratory is divided into a number of investigative sections specializing on separate phases of the general problem. As the mechanical properties of wood are probably those of the most direct interest to the majority of users, the largest section of the laboratory is given over to the study of them. The wood preservation section is organized to develop preservatives, wood treating methods, and measures to cut down the largest single item of preventable waste that occurs in timber produc-

**BENDING ARTILLERY WHEEL RIMS**

Prior to bending a wheel rim, it is steamed. It is then placed in the machine upon a sheet-metal strip and the end blocks are drawn in to bear down upon the squared ends. The two arms are then slowly drawn upward by means of chains and the piece is bent around the circular arc to conform to the wheel rim. A tension rod holds the ends together. When locked in this way the wheel rim may be removed from the machine and allowed to dry, whereupon it may be put to use

**TESTING A BUSHEL BASKET**

Special machines are used to test wood containers. They vary from small bench machines to huge tumbling drums which look like a feature in an amusement park. The work on containers has saved great sums

**PRESSING GLUED BLOCKS**

The operator is tightening the screws on glued test blocks. This material will later be made up into test blocks which will be tested by shear to throw further light on the best pressure and assembly time to use

**TESTING COW CRATES**

The cow crate shown at left is a type often used for livestock. The crate on the right was built according to a design developed by the Forest Products Laboratory. Some of the advantages which this crate has are greater rigidity, better protection to the animal, and easier loading. The rigidity is derived from the diagonal bracing; protection to the animal, from the greater length, from the built-in stanchion and from the heavier floor and closer spacing of boards near the floor

tion and use; that is, the destruction of wood by decay. Particular attention is paid to the fungi which stain or rot lumber. The derivation of chemical products from wood is extremely valuable because of the importance of the substances which we have thus far been able to obtain economically from no other source. The section of pulp and paper investigations is at present one of the largest and most active of the divisions of the Forest Products Laboratory, owing largely to the intelligent interest and co-operation of the paper industry. To assist shippers in improving the design of containers so as to obtain adequate strength with a minimum of lumber, the

Forest Products Laboratory operates a well-equipped section for container investigations. One way in which the laboratory makes its findings available to the wood-using industries is by means of short intensive courses of study under the instruction of members of the staff. The records of the laboratories are filled with interesting experiences. For example, a piece of wood from a bomb which had exploded and killed the intended victim's wife was identified by the wood technologists as being the same kind as the shavings found around the workbench of the man suspected of sending the bomb. We are indebted to the Director, Mr. Carlile P. Winslow, for many courtesies.



THE PRIZE DISCOVERY

In the center is the arrowpoint, still in position between two ribs of an extinct bison

The Editor Disclaims

IN the first two paragraphs of his most interesting article, Mr. Cook, the author, makes claims concerning the proof of the antiquity of man in America—claims which the editor regards as requiring a still larger volume of substantiation than the available evidence affords. With Mr. Cook's friendly concurrence, the present statement, in which the editor disclaims all responsibility for their inclusion, is published.

TO Fred J. Howarth and Carl Schwachheim of Raton, New Mexico, America is indebted for one of the most interesting and important discoveries of evidence concerning the presence of prehistoric man in the New World, during glacial or Pleistocene times. As more and more evidence comes to light, it becomes more and more obvious that this "new world" is not as new as it has been our custom to consider it. In fact, recent evidence proves it to be quite as old as the Old World, and it may have been inhabited by mankind quite as long. Some evidence at hand indicates that it may even have the older evidence of human occupation.

HOWEVER that may be, it is now obvious that mankind has lived on this continent for hundreds of thousands of years; and that even in early Pleistocene times had reached a stage of cultural development and civilization that was in some respects, at least, quite as advanced as any existing on earth at that time, insofar as present evidence indicates. Indeed the evidence now at hand, as a result of our recent studies and research in the field, testifies that mankind was even more advanced in the art of making stone implements in early Pleistocene times in America than in Eurasia, at least so far as denoted by present known data. Some of this has been given in earlier articles in the *SCIENTIFIC AMERICAN* and in *Natural History*.

Glacial Age Man IN New Mexico

*Remarkable Discoveries Made in the West
Again Raise the Question, "How Old
Is Man in America?"*

By HAROLD J. COOK

Honorary Curator, Department of Paleontology, Colorado Museum of Natural History

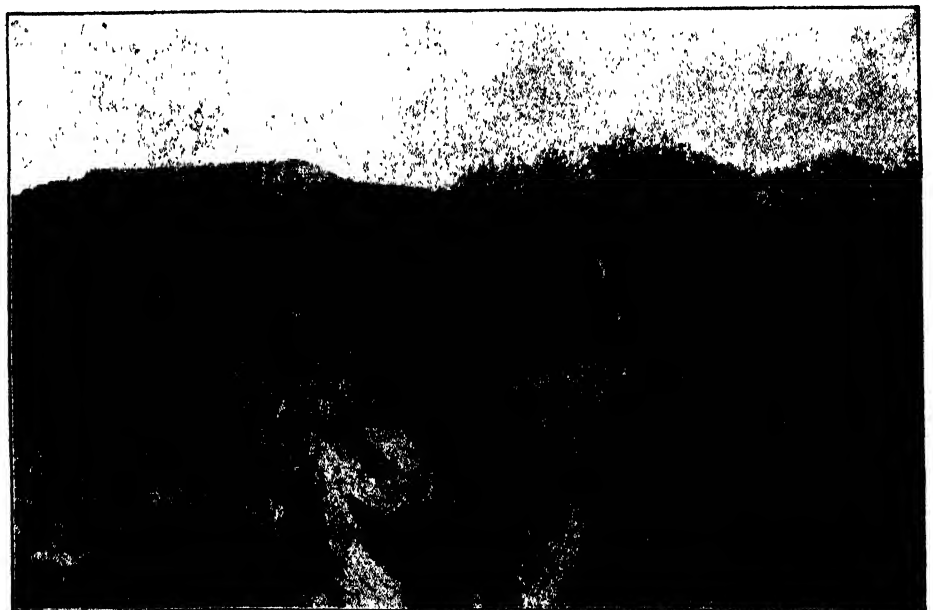
Some two years ago, Messrs. Howarth and Schwachheim reported their discovery at Folsom, New Mexico, of some fossil "buffalo" (bison) bones to the Colorado Museum of Natural History, and arrangements were made at once to look into it. Our preliminary examination indicated an important fossil deposit and early in the summer of 1926 a party set to work excavating and carefully collecting these fossils. As this work, carried on for the Museum by Mr. Frank Figgins and Mr. Carl Schwachheim, proceeded, two arrowpoints of splendid workmanship and distinctive design were uncovered, each deeply buried and both definitely associated with these fossils.

SPLENDID skeletons of a bison (*Bison taylori*), new to science, and far larger than our modern species, were collected. These bones were exceedingly fragile, and great care and skill were required to collect, prepare and restore them for mounting. From this season's collection the skeleton of

a large bull was mounted in the museum.

The following summer (1927), work was resumed in the quarry, and another large collection was made by Messrs. Schwachheim and Floyd Blair of the museum staff. Most of this is still packed in the field boxes in which it reached the museum, and is still to be worked out and studied in the laboratory. But in excavating in the field, more new arrowpoints were discovered. Five in all of this one distinctive type have been found associated with these extinct "buffalo." As work with the material progresses, it is quite possible that others will be uncovered, for it is quite easy to miss so small an object when taking out blocks of matrix filled with fossil bones in the field.

FORTUNATELY, one of these arrowpoints was located before it was loosened from the original deposit, while barely a tip of it was exposed. Here was the long-sought chance to show the world the occurrence and age



BEFORE EXCAVATION STARTED—FOLSOM BISON QUARRY

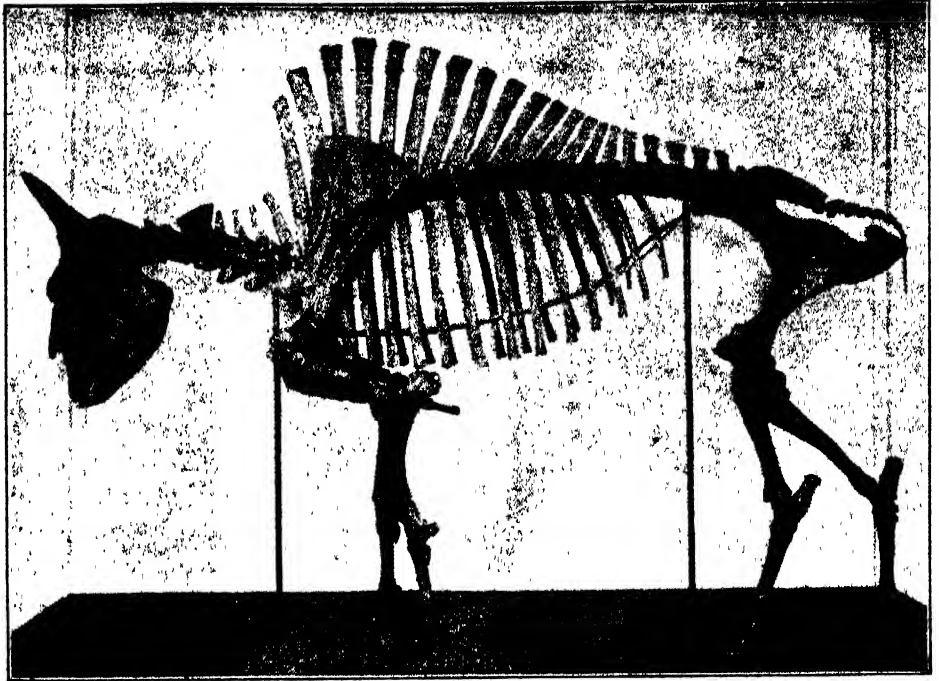
The dry gully or arroyo which cut through the fossil bed and caused its discovery on both sides walls occupies the center of the picture. The bone bed lies 8 to 12 feet below the surface

of these implements, and convince skeptics that such association was bona fide and beyond question.

In previous discoveries of this nature, the human artifacts found had been loosened from the original matrix before being seen by scientists from other institutions and, until such evidence could be critically examined by competent, disinterested specialists, in position as nature left it, many were still inclined to remain unconvinced. Consequently, telegrams were sent immediately by Director J. D.iggins, inviting several nationally known specialists to come to the spot and investigate for themselves.

AMONG those who came were Dr. A. V. Kidder, of Phillips Academy, Andover, Massachusetts, Dr. F. H. H. Roberts of the Bureau of Ethnology, Washington, D. C. and Mr. Barnum Brown, of the American Museum of Natural History, New York, all of whom were convinced of the authenticity and antiquity of this discovery. Mr. Barnum Brown was given the privilege of uncovering the upper side of this prize arrow. Later, it was carefully removed in a block, along with the bones with which it was associated, intact and undisturbed. In that form it is now on exhibition in the Colorado Museum of Natural History, at Denver, for all who care to see it.

The region where they were found is a most unusual one in which to find such fossils. Situated high up and near the head of what is virtually a mountain valley, in an area whose rocks are mostly lavas overlaying Cretaceous formations far too old to contain evidence of this sort, it is about the last place most collectors would set out for, in which to search for evidence of prehistoric man associated with



A BISON LIKE THAT WITH WHICH THE ARROW WAS FOUND

The mounted skeleton is now on exhibit in the Colorado Museum of Natural History at Denver. This species, Bison taylori, is extinct—how long since, is unknown. It was very large

fossils of this character. Conditions in and about the bison quarry show that the valley in which it is situated had been cut or eroded more deeply in Pleistocene times than it is to-day.

IN later Pleistocene times a refilling period set in, caused possibly by the temporary blocking of the valley below by a lava flow. In any event, on the old eroded surface of Cretaceous shales, clay-muds and silts are deposited. Their character indicates swampy conditions and comparatively quiet waters, at the spot where the bison are deposited, as the matrix is free from coarse materials such as sand and gravel, which characterize stream

beds in such a location as was this one.

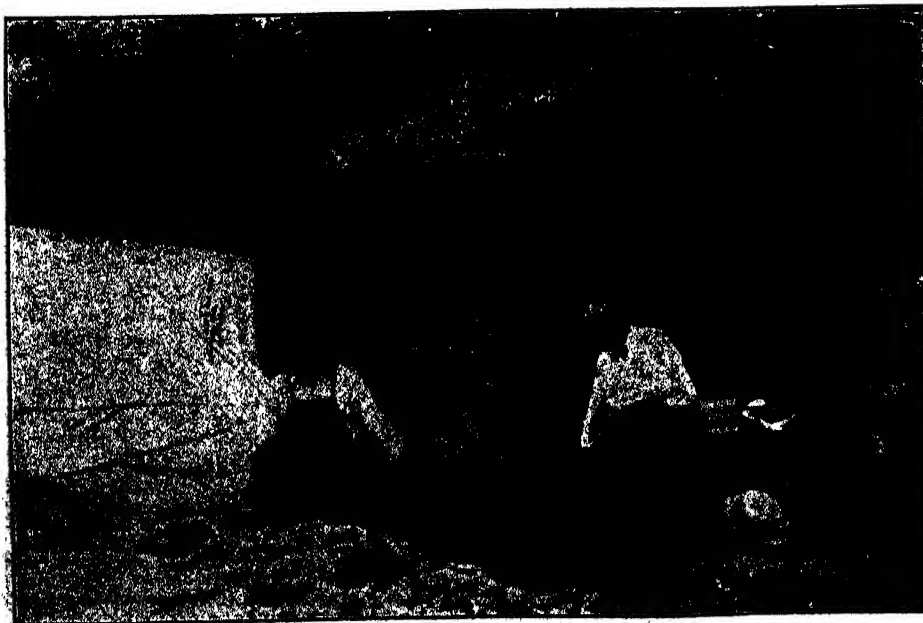
Another stage of recutting has set in comparatively recently, channeling back up across the present valley floor. A deep, narrow little gully or arroyo was thus formed by waters from hard rains and melting snows. This gully cut through the bone bed, destroying part of it, and leaving the ends of bones exposed in its two walls, which led to their discovery.

Three principal phases of deposition are represented in these sediments, two of which overlie the level in which the fossils and arrows occur. The bone bed lies at a distinct angle, dipping down to the north across the arroyo, and lies at a depth of about eight to twelve feet below the present surface.

Fortunately, Mr. Fred Howarth, formerly connected with the United States Biological Survey, realized their possible importance when he saw them, although no one connected with the discovery really expected to have the good fortune that has followed operations there.

AFTER our earlier discoveries at Colorado, Texas, (described in the SCIENTIFIC AMERICAN, November, 1926), we knew and discussed the possible chances of finding evidence of prehistoric man here, and everyone was warned to keep the sharpest watch for such; but it was almost too much to hope that our wishes could be fulfilled in such a manner as they were.

The fact that these arrowheads were found under the conditions they were, makes it possible to designate it as evidence of a definite cultural stage, for which the name "Folsom Culture" has been suggested. They are rather large for arrowpoints, and



WHERE THE ARROWPOINT WAS DISCOVERED

Mr. Carl Schwachheim points to the arrowpoint, which is still in position where uncovered. Mr. Barnum Brown, well-known vertebrate paleontologist, who uncovered it, kneels at the right



THE QUARRY AFTER PRELIMINARY STRIPPING

The skeletons remain in the central mass which has been carefully isolated. From this stage on, the work demands skill, care, and patience

small for lance points; but no matter which their use was, their purpose seems clear, and it seems entirely likely that they were carried to this spot in the bodies of these bison.

Of course such an animal might be shot in countless places by an arrow, and still escape his human enemy to carry the points away in his wounds. Buffalo like to wallow and roll in mud-holes, as is well known; and wounded, feverish animals would naturally seek cool waters to lie down in when suffering from such wounds. No doubt some of the animals whose skeletons we find here did just this and, lying down, never got up again.

A glance at the illustrations will show

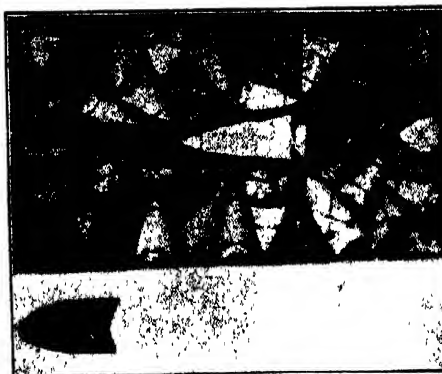


MR. SCHWACHHEIM PAUSES

Here he stands close beside the bone bed, which shows in the lower left-hand corner

the shape and form of these arrows better than words. The most striking feature is that, after they were chipped out and formed, a long thin flake or chip was taken out of both sides, lengthwise, from the rear toward the

point, leaving the arrow, in cross-section, with a hollow-ground effect. To do this required a higher degree of skill in the art of stone working than that possessed by most races which have made stone implements. Those primitive people, in shaping the flints, caused this long chip to break out in a most skillful manner. It is not easy to understand how this could be done without its breaking out crosswise and ruining the point. Of course, this



FROM EASTERN COLORADO

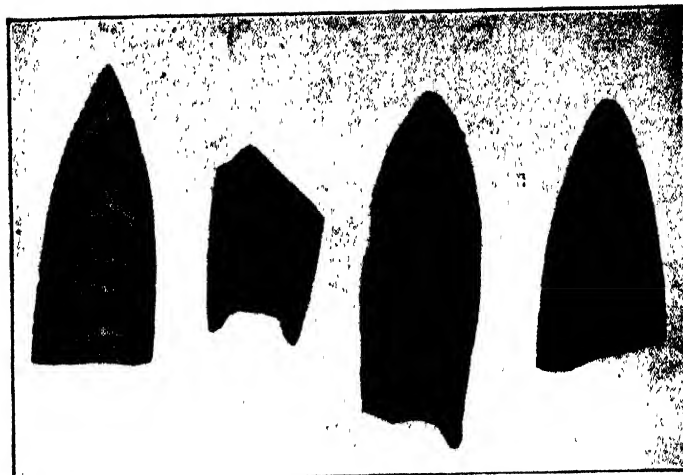
A typical collection of arrowpoints which was later found to include two of Folsom type (one of these is in the corner)

chipping takes advantage of the conchoidal fracture characteristic of this class of stones, but utilizes it in a remarkable manner.

The double grooving of the arrows probably served two useful purposes. It offered a good seat on which to secure the shaft of the split stick on which it served as a point or head; and second, such a point permitted a wound to bleed more freely. Bayonets similarly shaped were used in the World War.

The materials from which these points were made differ somewhat in each specimen, but all belong to the one general class of silicates, comprising flints, chalcedony, agate, jasper and their related varieties.

A few other points of this same general type and design have been lo-



FOUR OF THE SPLENDID ARROW POINTS

The editor, who has handled the points, feels that the pictures fail to convey their extreme refinement. They were the work of an expert

cated at other points in New Mexico and Colorado, either on the surface or mixed with more modern types of workmanship at village sites; but all are from an area probably traversed by the race of men that killed the Folsom buffalo. Although a few points have been found in association with those of more modern type, they had probably been discovered and picked up by later Indians, after having been eroded out from their original place of deposition where buried or lost by their makers. There is no data at hand to indicate their manufacture in this country by more modern races, although modifications of this type are comparatively common.

Until other discoveries are made, it is premature to say what manner of people this evidence represents. Perhaps they were a wholly different race. Who knows?



IMPROVISED SHELTER TENT

At times violent, sudden storms interrupted the progress. Work continues this summer

How the Weather Man Outreaches the Airplane

tions reproduced on this page indicate, the sounding balloon is designed to carry aloft scientific apparatus of light weight, and balloons of this type have been sent to an elevation of about 22 miles; the pilot balloon referred to above is smaller and carries no apparatus, hence flies to 24 miles elevation. The illustrations on this page show sounding balloons.

"The registering apparatus sent aloft by these various methods," says the noted meteorologist, Dr. William J. Humphreys, Chief Physicist of the United States Weather Bureau, in his "Physics of the Air," "furnishes reliable information concerning the composition (including humidity), temperature, pressure, direction of motion and in some cases, velocity of the air, from the surface of the earth up to the greatest elevation reached. And it is this automatically recorded information, gathered, with but little exception, since the beginning of the Twentieth Century, that has so greatly extended our accurate knowledge of meteorology and done so much to make of it an interesting and profitable branch of both theoretical and applied physics."

The balloon activity depicted on these pages is at the Lindenberg Observatory, near Beeskow, Germany, but the methods employed are virtually the same the world over. Professor W. H. Hobbs, leader of the University of Michigan Expedition to Greenland, has released many sounding and pilot balloons over that land, in his recent



THE OBSERVATION

With the theodolite, a pilot balloon is being observed in its flight. When thus checked simultaneously from two stations the course of the balloon may be plotted by triangulation

efforts to study the meteorological conditions of the arctic. It is his belief that much of the weather of the north temperate zone is "brewed" in the high, cold plateau of Greenland, and observations he is now conducting may prove of great practical value.

THE RELEASE

Beneath the balloon is a light weight parachute which is automatically detached when the balloon has reached its "ceiling." The parachute "rescues" the recording apparatus

MAN has flown about eight miles above the surface of the earth but the meteorologist seeks to extend the domain of his scientific investigations far higher than this. For this purpose, the sounding balloon and the pilot balloon serve better than anything so far devised, although recent research gives promise that powerful rockets will some day be able to rise far higher, if not entirely out of the earth's atmosphere. As the illustra-



All photos by Underwood and Underwood

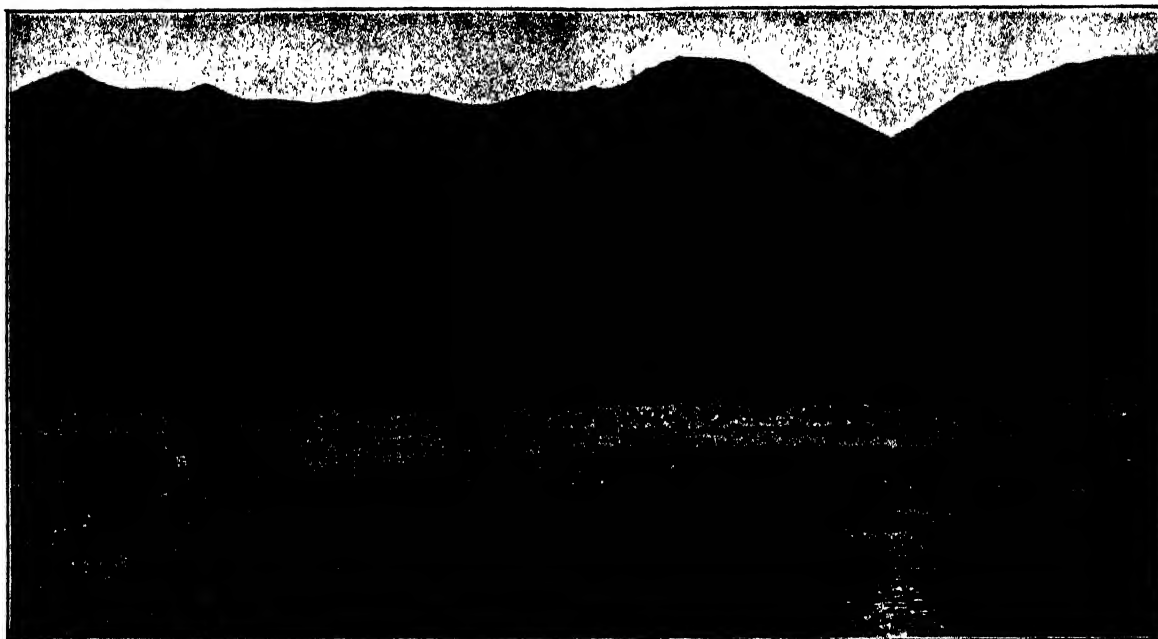
SENDING UP A SOUNDING BALLOON

The nature of the parachute and the simple package containing the automatic recording apparatus are clearly shown. The picture contains other, unrelated apparatus which is not taken aloft



CHECKING UP WITH A RANGE FINDER

A pilot balloon may be watched in flight by means of an optical range finder. This makes its triangulation automatically, doing the work of two theodolites—that is, it provides its own permanent baseline



Courtesy American Museum of Natural History

TYPICAL COUNTRY OF NORTHEASTERN SIBERIA

The part of Siberia in which the meteoric fall took place is mainly covered by forests of conifers, but

there are local areas which are more or less like tundras. The real barren tundras are farther north

The Great Siberian Meteorite

An Account of the Most Remarkable Astronomical Event of the Twentieth Century, from Official Records

By CHAS. P. OLIVIER, Ph.D.

*Chairman, Meteor Commission, International Astronomical Union
Astronomer at the Leander McCormick Observatory, University of Virginia*

THE readers of the SCIENTIFIC AMERICAN will remember the very interesting series of papers on Meteor Crater, Arizona, by D. M. Barringer, Jr., that appeared last July, August, and September. Meteor Crater has often been described as "the most interesting place on earth" to the scientist, and most justly so.

There undoubtedly we have a great crater nearly a mile in diameter and several hundred feet deep, made by the fall of an immense group of meteorites or, more properly speaking, the head of a small comet. All evidence is that the fall took place well within historic times, even if no authentic account survives and only a few Indian legends may be connected with it. The actual exploration of this crater, now under way, will, it is hoped, in the near future give us information of the vastest importance.

Recently reports have been reaching the scientific world of a wonderful meteoric fall in one of the most inaccessible parts of Siberia. During the past year there have been several references to it in scientific and popular journals, but the official account of the exploration of the locality by an expedition sent out by the Academy of Sciences of the U. S. S. R. (as Russia

now calls itself) has only just been received. This expedition was under the direction and leadership of Prof. L. A. Kulik, and the following details are taken from his report, which must be considered the first authentic and scientific account to be published of this most remarkable phenomenon.

The reason that most of the world has remained in ignorance of this meteoric fall has been due both to the difficulty of communication with Russia in general and to the fact that nearly all publications from that country now appear in Russian, which few foreigners can read. So the earlier notes on this fall seem to have been largely overlooked and only recently has attention been focussed upon it outside of Russia itself. Yet Prof. Kulik published a note upon it as early as 1921.

THE fall itself occurred on June 30, 1908, in the upper basin of the river Podkamennaja Tunguska, in central Siberia, at about latitude 60 degrees north, and longitude 101 degrees east of Greenwich. The sparse population of the region, its distance from any centers where there were many Russians, and the generally disturbed condition of the whole country for the past 25

years, will readily account for the slowness with which the rest of the world has learned of it.

From other sources we are informed that seismographs at Irkutsk and Kirensk, 800 miles and 300 miles, respectively, from the place of fall, registered the shocks. A barograph at Kirensk also registered the accompanying air-wave. The general direction of motion of the meteorites seems to have been from S. S. W. to N. N. E. It is barely possible, according to recent calculations by V. A. Maltzev, that these bodies had formerly been connected with Pons-Winnecke's Comet—the one which was visible last summer.

The expedition under Prof. Kulik reached the general vicinity of the fall in March, 1927, and made its base at a small trading station named Vanovara, situated on the above-named river, about a hundred kilometers to the southeast of the area to be investigated. The country is described as rough, hilly, with many swamps and small lakes, and much of it densely covered with tundra. This last was so difficult to penetrate that, after numerous attempts, members of the expedition were forced to employ small rafts and work their way slowly to the northwest, using the system of rivers which inter-

sect the district. Finally, in June, they reached the spot and a preliminary survey was made. Apparently they arrived with a very small scientific equipment, for they were unable to make many of the kinds of observations that Prof. Kulik desired, and which he states are necessary. But his survey was quite sufficient to prove that whatever did happen was the most astonishing phenomenon of its kind in scientific annals.

THE central part of the affected area which is altogether 15 or 20 miles in diameter, covers an area of several square miles and is situated on the plateau between the rivers Chunia and Podkamennaja Tunguska, where there is a sort of enormous amphitheater formed by the surrounding mountains. This valley has many hills, swamps, creeks, and is largely covered by the tundra. The natives assured Professor Kulik that the whole valley was formerly covered by woods. The trees are now bare, without bark or limbs, and almost all lie on the ground with their tops turned away from the center of the spot, thus giving a sort of fan effect which is plainly visible from the tops of some of the surrounding mountains. Here and there some tree trunks still stand and, in a few isolated and very sheltered spots, some that are still living. But the region is in general now most desolate.

All the vegetation shows the effects of a uniform and continuous scorching, which does not in the least resemble the consequences of a forest fire. The scorching is visible also on the moss and bushes, as well as the trees, and some signs of it appear as far out as 6 to 10 miles from the center.

But the thing which gives the whole phenomenon its most decidedly meteoric character is the presence of innumerable "shell-holes" or craters which vary in diameter from one to perhaps 50 yards in diameter, scattered all over the central area. Their edges are mostly steep, the bottoms flat and swampy, and sometimes with traces of a central elevation. Actual digging into one of the smaller "shell-holes" for a few yards depth did not yield any meteoric mass, but in such ground this was hardly to be expected, for a solid mass would undoubtedly sink to some depth, and the expedition was not equipped to dig deeply in soil in which water was always present just a little way below the surface.

No exact mention is made of the area covered by these "shell-holes," nor whether any of them occurred upon higher ground where digging would not be interfered with by water. But the inference is that they were confined to low ground which by chance formed the exact central area.

From those who actually witnessed the phenomenon Professor Kulik was able to obtain several very good accounts. Perhaps the best was that by a peasant, S. B. Seminov, who was on that date at the station Vanovara. He says:

"About eight o'clock in the morning, I had been sitting on the porch



Courtesy American Museum of Natural History

TUNGUSES AND SUMMER TENT

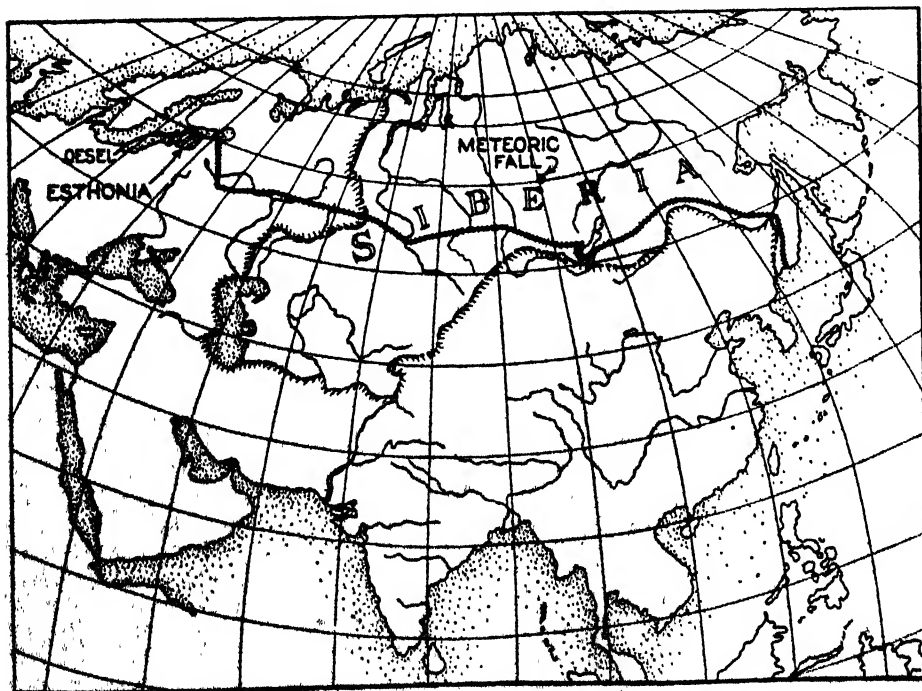
The Tunguses are a northern Mongol people kindred to the Manchus. They inhabit most of Northeastern Siberia and are nomads. To some extent the Slavs have penetrated Siberia

with my face to the north, and at this moment in the northwest direction appeared a kind of fire which produced such a heat that I could not stand it. . . . And this overheated miracle I guess had a size of at least a mile. But the fire did not last long, I had only time to lift up my eyes and it disappeared. Then it became dark, and then followed an explosion which threw me down from the porch about six feet or more . . . but I heard a sound as if all houses would tremble and move away. Many windows were broken, a large strip of ground was torn away, and at the warehouse the iron bolt was broken. . . ."

PROF. KULIK also learned from one of the native Tunguses that the spot where all the trees are now dead had previously been used by a rich relative as a pasture for a large herd of tame deer. After the fire they went to find the herd and found many scorched carcasses, but never found a large part of the herd, dead or alive. Also some small storehouses in which the man used to keep implements, and so on, were all completely ruined; everything in them being either burned or melted, so that only a few buckets remained fit for use out of all his property. There were other eye-witnesses, both Russian peasants and native Tunguses, whose accounts tallied in essentials with those mentioned above.

Professor Kulik concludes by outlining the sort of work that must be undertaken by a scientific expedition, on a larger and more complete scale, before it would be wise to begin digging for the actual fragments. He further calls attention to the fact that we have no record of the fall of any other meteoric mass which brought along with it a vast envelope of hot gases, and which did such damage over a large area.

In looking over this account, one has to admit that many accounts of



SHOWING WHERE THE METEORIC FALL TOOK PLACE

The distance to the Trans-Siberian Railroad, which is indicated on the map, is about 400 miles. The editors, who prepared the map, have also indicated on it the locality referred to on page 45



Courtesy of American Museum of Natural History

A TYPICAL NORTHERN SIBERIAN LANDSCAPE

While no actual photographs of the exact locality described are as yet available, this and others published will suffice to give a general idea of the kind of country where the meteorite fell

events in old chronicles that have been laughed at as fabrications are far less miraculous than this one, of which we seem to have undoubted confirmation. Fortunately for humanity, this meteoric fall happened in a region where there were no inhabitants precisely in the affected area, but if such a thing could happen in Siberia there is no known reason why the same could not happen in the United States.

FROM the standpoint of meteoric astronomy, the final verdict can scarcely be given until some fragment of the fallen mass can be produced, and the region fully studied. But good reasons have been given why this, so far, has not been done. The available evidence points perhaps to a much less dense mass of meteorites than that which formed Meteor Crater in Arizona, but it also seems to have had a larger cross-section. When it struck the ground it was surrounded by an immense envelope of extremely hot gases, but it is a question whether much of this gas had accompanied the solid masses through space, or whether most or all of it was not simply some of our atmosphere carried along by the passage of the solid masses through it, as we know to be the case for even small meteors. Lacking further evidence the writer would guess that the latter was the case.

But it is certain that the velocity of the masses when they struck the surface of the earth was very much greater than is usually the case for a single meteoric mass, which never has been known to penetrate very deeply into the soil. This would mean that these masses presumably will be found at considerably greater depths than usual. The fact that the bodies fell at eight in the morning also inherently proves that the velocity, relative to

that of the rotation of the earth's surface, was greater than that of the average meteorite, most of which fall in the evening hours.

The area of the larger "shell-holes" or craters further proves that some of the individuals were of considerable size, probably a yard or two in diameter, as a lower estimate. Not until specimens are recovered will it be possible to give even an intelligent opinion as to their probable constitution, that is, whether they are stony or iron meteorites. A photograph from an airplane, as Professor Kulik suggests, would be invaluable, for it would show the distribution and number of these craters,

without which information we can form no just estimate of the number of bodies which fell.

If we seek through a search of scientific literature to find a parallel effect produced on vegetation we find that only by a volcanic eruption has one more or less similar been brought about. But unless the explosion took place in the center of the affected area this possibility is at once ruled out, and as no mention is made of volcanic phenomena in the report of the expedition, presumably this cause cannot be assigned.

IT is hoped that no pains will be spared by the proper authorities to investigate fully and explore this region in the near future, for each year that elapses will destroy some of the evidence. Certainly what we now know of it places this phenomenon in a class wholly by itself, and not only meteoric astronomy but science as a whole will profit greatly by the solution of the many interesting problems that it presents.

The assistance of Dr. A. Vyssotsky of our staff is most gratefully acknowledged for the translation of the original document, without which the writer would have been unable to undertake the preparation of this article.

AN old controversy in science has been revived by the recent statement of a noted American scientist, that the living races of man are direct descendants of the ugly, ill-formed Neanderthal species. In a coming issue, a famous authority on man's bodily evolution will attempt to controvert that claim.



Courtesy American Museum of Natural History

A TUNGUS FAMILY AT HOME ON A SUMMER DAY

Siberia is peopled with many widely differing peoples. The Caucasian race has infiltrated only along the line of the great railroad and in isolated spots where commerce brings them

A Miniature Meteor Crater

A Circular, Crater-like Depression in Esthonia Bears at Least Superficial Resemblance to the Famous Crater in Arizona

By ALBERT G. INGALLS

GEOLOGISTS of the University of Dorpat in the small country of Esthonia lying between Russia and Scandinavia, on the eastern shore of the Baltic Sea, are endeavoring to discover the mysterious origin of a peculiar geologic feature on the nearby island of Oesel or Saaremaa. (See map on page 48.) There, 14 miles northeast of the ancient city of Arensburg, or Kuresaar, in the immediate vicinity of the little village called Kaali or Salle, is a nearly circular depression like a crater, not more than 800 feet in diameter and surrounded by a wall or rim which stands 15 or 20 feet above the level of the plain in which the strange depression occurs.

The question which intrigues the local geologists is whether this anomalous feature of an otherwise flat, featureless landscape is simply an ordinary case of ground water solution of the rock with the caving in which commonly produces what are known in the American middle west as "sink-holes," or whether we have here another though smaller "Meteor Crater" like the famed mile-wide depression in Arizona which is now being probed by means of a shaft for the large meteoric aggregate which is thought to have excavated the crater in its fall.

These two theories—the sink-hole

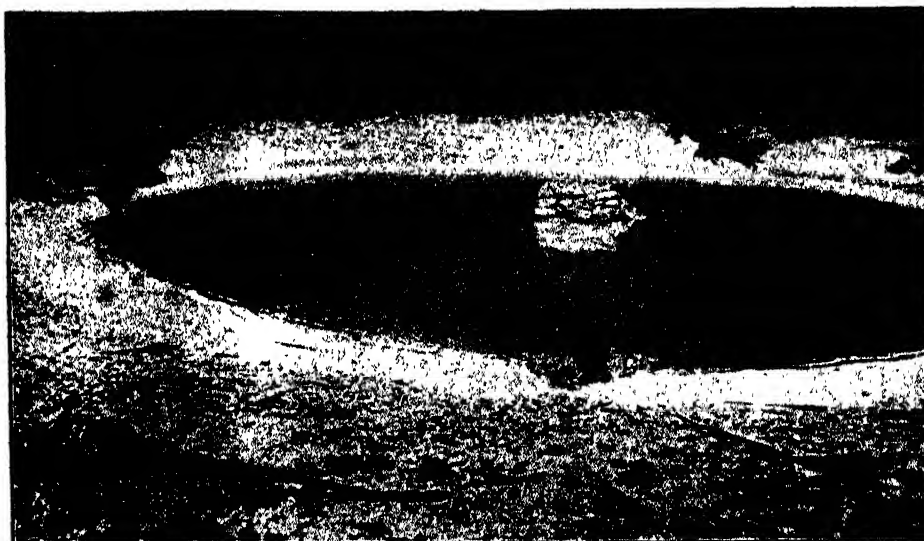


Photo by M. Jacobson

THE SMALL LAKE IN THE CENTER OF THE CRATER

The lake is 14 feet deep, but it does not occupy all of the crater. From a geological point of view its presence in the bottom of the depression is not significant

theory and the meteoric crater theory—coincide with two of the three theories originally advanced to account for the Arizona crater, and have been mentioned by the well-known geologist, Professor Alfred Wegener of the University of Graz, Austria, the same Professor Wegener whose theory of drifting continents has been widely dealt with in popular journals. The third or volcanic theory of the origin of craters has not been introduced in this case, because there are no signs of volcanic activity within hundreds of miles of Esthonia. Nor does the glacial moraine, kettle-hole hypothesis seem to fit the circumstances.

THE particulars of the description of the crater on the island, which forms a part of Esthonia, were furnished by Mr. Konstantin Komets of Reval, capital city of that nation. The surface soil, he states, is black earth with clay beneath, then sand, reaching in all to a depth of about 10 feet. Below this is dolomite. This variety of rock is closely allied to limestone, being composed of the carbonates of lime and magnesia. This renders it necessary to take very serious account of the sink-hole theory, for dolomite, like limestone, is soluble in ground water and it would not be far-fetched to attribute the origin of a crater to the same agency which often dissolves out limestone and brings about the formation of the familiar sink-holes which sometimes engulf whole fields when the fall of the unsupported surface strata suddenly takes place.

There are, however, several other features which seem to provide a peg on which to hang, at least tentatively, the meteoric theory. The crater, so far as its actual depth is known, ignoring any silting up which may have taken place subsequent to its original formation, extends to 80 feet below the top of the exposures of dolomite, the total thick-

ness of which our correspondent does not specify. Under this dolomite a deposit of dolomite powder mixed with larger stones has been found. This, taken in conjunction with the stated facts that the rocks of the crater's rim are tilted up as if resulting from the impact of a projectile, as are some of those in the rim of the Arizona crater, and secondly, that the rim of the crater stands 20 feet higher than the outside level of the plain, constitute a mass of evidence which demands further consideration of the hypothesis of meteoric origin.

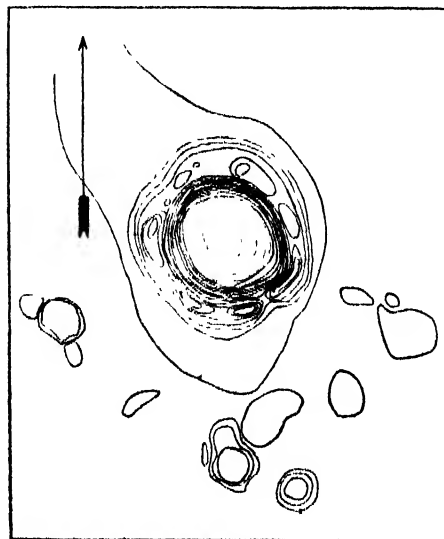
Within a distance of half a mile, as shown by the accompanying contour map furnished by Mr. Komets, there are 12 or more smaller craters ranging from 100 feet down to 15 feet in diameter. It would seem that, if the main crater owed its origin to the same events which excavated the colony of small craters, and if this was truly the impact of a swarm of meteorites, it ought to be possible to settle the question by exploring a small crater.



Courtesy of A. Lohs, University of Dorpat

A PART OF THE WALL

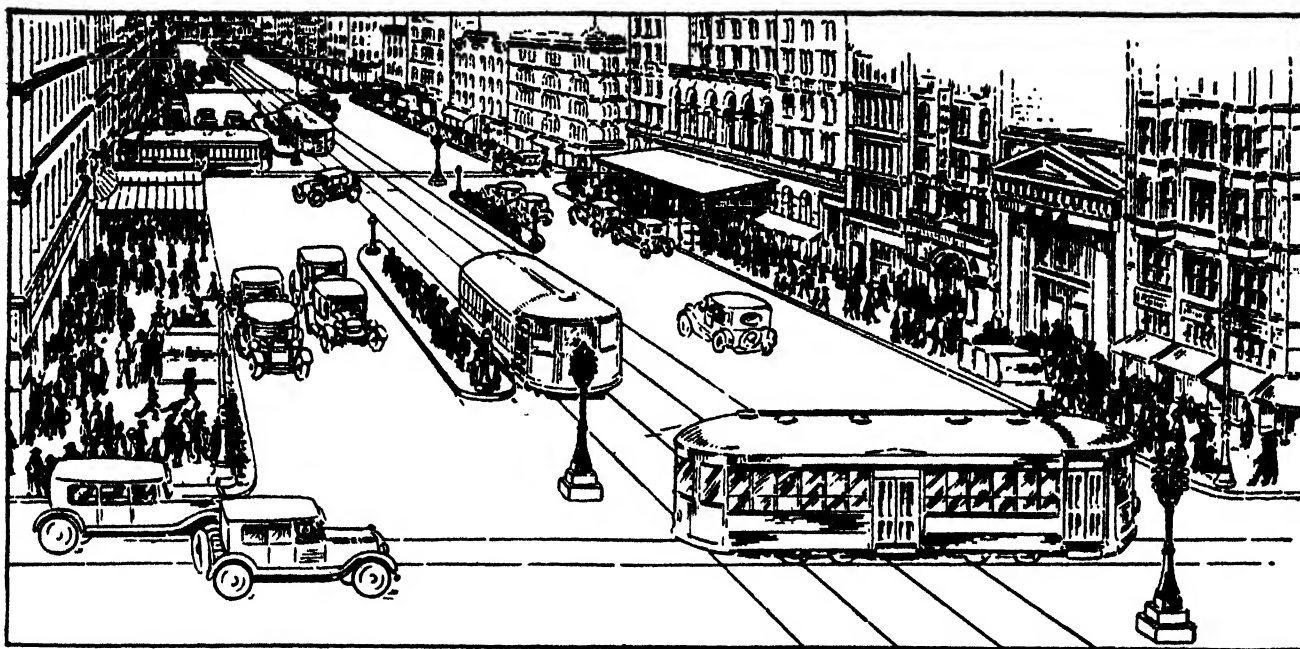
What forces tilted these strata? See map, SCIENTIFIC AMERICAN, July 1926, page 58



Courtesy Mining Department, Esthonia

MAP OF THE CRATER

Contour interval is one meter. A colony of small craterlets is indicated at one side



All illustrations courtesy American Gas Accumulator Company

AN ADEQUATELY REGULATED TRAFFIC ZONE

In this illustration, "Stop and Go" signals are so placed that they not only control traffic by their changing lights, but they also regulate the

flow of vehicles so that each is kept in its proper lane. Safety zones for pedestrians also have a very definite regulating effect on vehicles

Traffic Regulation

An Analysis of Accident Causes, and Suggestions for Correction. Traffic Beacons and Safety Zones Can be Made of Great Value When Properly Placed

By GUY KELSEY

Traffic Engineering Division, A. G. A. Company

TRAFFIC regulation is defined as means by which the movement of traffic is confined to proper channels and disorderly movements are prevented. A signal to accomplish this is a *regulating* signal. *Traffic control* refers to means by which traffic may be halted. A "Stop and Go" signal is a *control* signal. Regulating signals should be used at the majority of intersections to maintain a fluid and orderly movement of vehicles and to safeguard pedestrians. Control signals should be used at heavy traffic points and only during the hours when traffic is heavy.

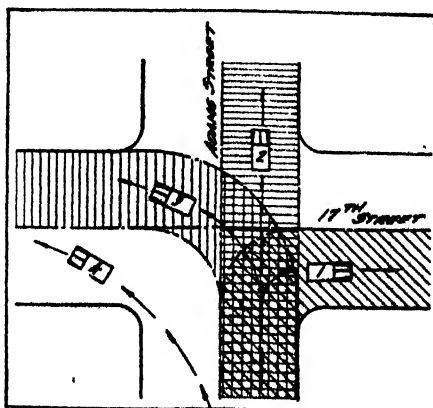
IT is often wise to install control "Stop and Go" signals on pedestals in the throats of the minor street to operate "Stop and Go" during heavy traffic hours, to be turned on as flashing signals during light hours and allow the continuous safe movement of traffic without stopping, and to regulate the movement of traffic and safeguard pedestrians at all hours. In this way, the signal lights may be placed in the position of greatest visibility. Traffic control and traffic regulation are thus provided for the

same expenditure and an efficient 24-hour treatment is the result.

Accident data indicates that 90 percent of traffic accidents occur outside of business hours, and that 75 percent of all accidents occur at street intersections. Heavy traffic is the safest. As a matter of fact it is about 15 times safer to cross the street through heavy traffic in business hours than at night when traffic is light. This

illustrates the truth that the accident hazard decreases as congestion increases and vice versa.

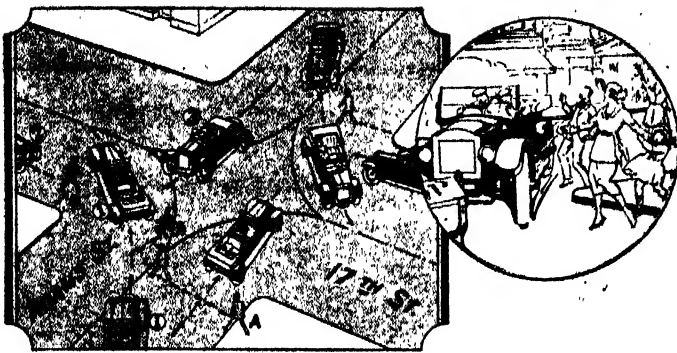
A traffic accident is the result of something unexpected and unlooked for, and is not a premeditated act. Irregular movements, particularly those arising out of left turns, are the cause of most intersection accidents. Such irregular movements introduce uncertainties which result in accidents.



KEEP TO THE RIGHT

Figure 1: If there were no such rule, many of our streets would be impassable. This rule divides traffic into two separate lanes

WITHOUT the rule "Keep To The Right" our streets would be impassable. This rule divides the street into two parts; traffic goes north, for example, on one side of the street, and south on the other. It will be clear that vehicle 1 in Figure 1 turning right, or vehicle 2 going straight through, are not likely to get out of their proper channels. Vehicle 3, turning left, continues in its proper channel in Adams Street to the near curb line of 17th Street and enters on the right side and in proper path in 17th Street. Vehicle 4, making a short cut left turn, gets into the wrong channels of both Adams and 17th Streets and violates the rule "Keep To The Right."



UNEXPECTED LEFT TURNS

Figure 2: In this case, car 1 is making an improper left turn, and is traveling faster than it should. The result is complete confusion

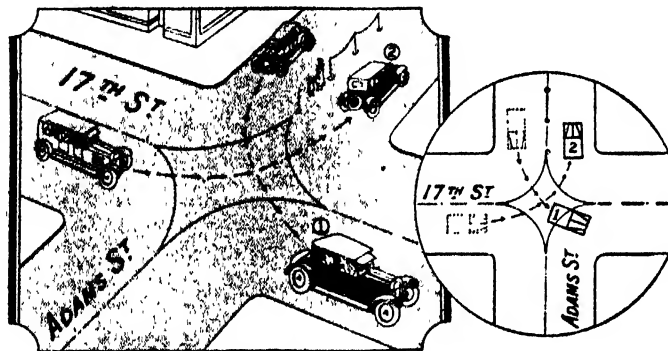
In Figure 2, driver 1 is making a short left turn and is going faster than he should. Pedestrian A saw car 1 coming, but expected it to pass behind him, and turned his attention to car 3 as his next danger. He just escapes. Pedestrian B looking, as he should, in the direction of car 2, steps directly into the path of car 1. Driver 3 is looking in the direction of car 2 and sees car 1 almost too late to avoid an accident. In each case drivers and pedestrians were looking in another direction and had no reason to expect the dangerous movement of car 1. Vehicles making a short left turn move on the wrong sides of two streets and always strike from behind.

CAR 1, in Figure 3, cutting the corner at speed started all the trouble. Pedestrians A and B, looking for cars in other directions, just save themselves. Driver 2 deflects left to avoid accidents and car 3, in dodging him, collides with car 4. Driver 1 goes his way and driver 3 will be charged with reckless driving. Car 1 in cutting short, started a general disorder and unexpected movements which resulted in an accident.

Suppose that stanchions are placed in a row, as shown in Adams Street, Figure 4. They compel driver 1 to stay in his proper channel until he comes out to the curb line of 17th

Street. Turning left from this point, he finds it hard to enter 17th Street, except through the correct channel into that street. In fact, the faster he moves, the surer he is to make the turn correctly.

In the same manner, driver 2 finds he must continue out to the curb



ENFORCING PROPER PATHS

Figure 4: By the placement of a row of stanchions in Adams Street as shown, cars must stay in their channels until at the turning point

line in 17th Street to make the easiest turn into Adams Street. If he cuts short, he is blocked by the row of stanchions. Both drivers find improper left turns blocked and correct turns the only ones they can make conveniently.

Suppose a barrel is placed in the throat of Adams Street and on the curb line of 17th Street opposite the row of stanchions, as in Figure 5. This treatment would correct the left turns into and out of that side of Adams Street. It would have the

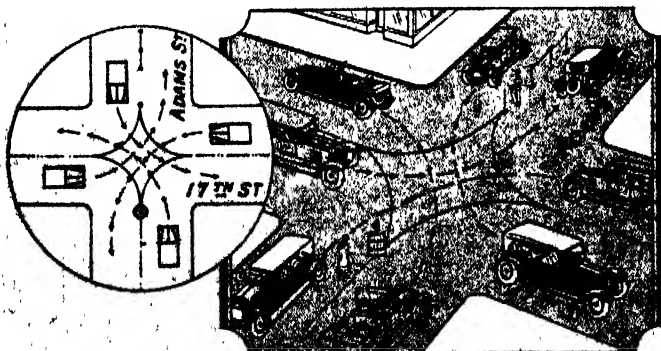
same effect as the row of stanchions on the other side of the street. The basic requirements of a signal to regulate the movement of traffic and to keep it orderly will be met if a light is placed on the barrel at night. The completed treatment shown corrects all left turn movements within the intersection, keeps traffic in good order and in proper channels.

THE preceding illustrations establish that: traffic may be expected to take the easiest and most convenient course; that the short-cut left turn produces unexpected movements, disorder, and accidents at intersections; and, that one way to prevent the disorder which causes accidents is to place signals in the path of traffic, so that they obstruct improper movements. This can be done

without interfering with proper traffic paths.

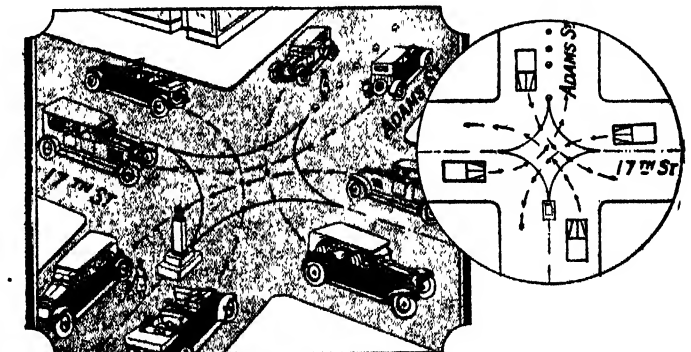
The treatment shown in Figure 6 employs a signal in one throat of Adams Street to warn traffic in all directions and a row of marker buttons which produce the effect of a curbing, in the opposite throat.

In some street intersections, one signal is not adequate and two must be placed in service. In Figure 7 note the safety zone or refuge value of the installations to pedestrians crossing the streets through traffic.



OBSTRUCTING WRONG MOVEMENTS

Figure 5: An obstruction placed in Adams Street, in addition to those shown in Figure 4, serves to aid still more in regulating traffic



TRAFFIC SIGNAL AND MARKERS

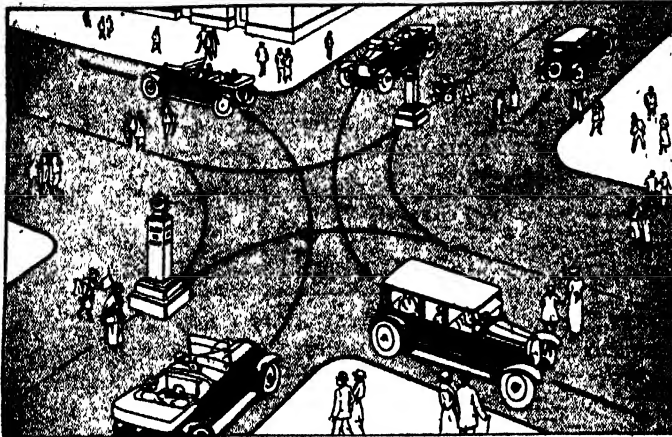
Figure 6: A further treatment of the corner illustrated in Figure 5 at the left is the use of a flashing beacon and a row of marker buttons

Properly placed, signals to regulate traffic, as shown, will pass more vehicles and pedestrians with safety than before treatment. The reduction of accidents usually exceeds 90

remains solved, and accidents and congestion have been eliminated. Three triangular areas were installed with flashing beacons on the traffic approach ends. These installations limit

most of our traffic troubles. A check of motorists striking signals indicates that over 75 percent were under the influence of liquor.

Signals, properly placed in the street,



SAFE ZONES FOR PEDESTRIANS

Figure 7: Here flashing traffic beacons are placed at both sides of the cross street. Note how they serve as refuges for crossing pedestrians

percent. Signals which regulate traffic movements without the "Stop and Go" feature place the emphasis on the "Go" and not on the "Stop," an important point, since unnecessary delays to traffic place an excessive burden of cost on the community.

IT required four officers to handle the intersection in a large city park, shown in Figure 8. Traffic intersected at sharp angles, in some cases almost head-on. With plenty of space, traffic tends to roam. In this case each driver suited his convenience as to routing, thus increasing the confusion. There were six major intersection areas (shown shaded), which formed a series of dams in the path of the main streams of traffic. Traffic seemed to come from and to go in all directions. There were no definite channels for traffic. No one knew what the others would do and the resulting disorder caused accidents, confusion, and, during rush hours, serious congestion.

The problem was solved, as pictured in Figure 9, and all four officers transferred to other duties in 1921. In spite of greatly increased traffic, it

traffic to definite channels. Wrong movements are obstructed without interfering with proper paths which were made most convenient. Six intersection points are reduced to three which are at right angles and out of the way of traffic moving along the sides of the area. Pedestrians have safety zones for their protection. Everyone knows definitely what to expect of everyone else.

EACH step in this analysis has been carefully checked by many observations at street intersections over a period of years. In addition, thousands of difficult traffic problems have been successfully treated and accidents eliminated through the application of the principles outlined.

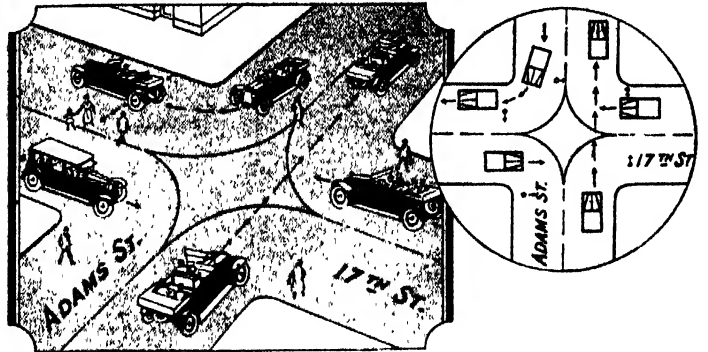
Signals in the street are believed by some to interfere with traffic, because they are sometimes struck. Many officials, however, consider that the more a signal is hit, the more apparent the need for it.

It is felt that if a motorist strikes a signal, he will strike other vehicles, or certainly hit pedestrians who carry no lights, and that such a motorist is one of that small group which causes

do not interfere with traffic, but are an aid to its fluid and safe movement, and even clear up congestion at an intersection.

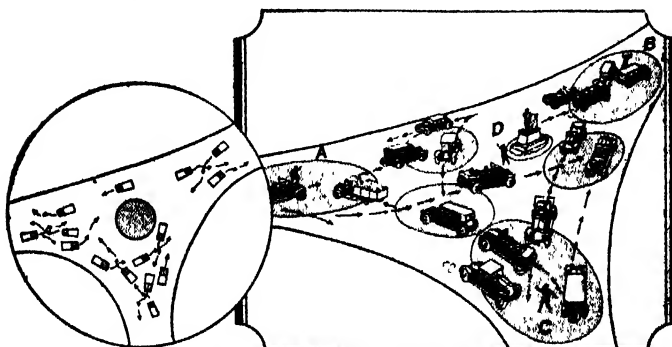
IN conclusion, it is suggested that the ultimate solution of traffic accidents at street intersections is the elimination of disorderly movements and the channelization of traffic. This can be accomplished by a signal correctly placed in the throats of intersecting streets.

According to a recent report of the Commissioner of Motor Vehicles of the state of New York, it is the experienced driver, or rather the driver who has been operating a car for a long time, who creates a greater percentage of the accidents than the driver who has possessed his license but for a short time. This is due, no doubt, to the fact that experience is likely to breed recklessness, whereas the newer driver does not have the confidence to take chances. The moral is obvious: Take no chances; keep to the right; obey traffic signals. If these three rules are kept in mind, traffic accidents will be reduced to a minimum and congestion will be relieved.



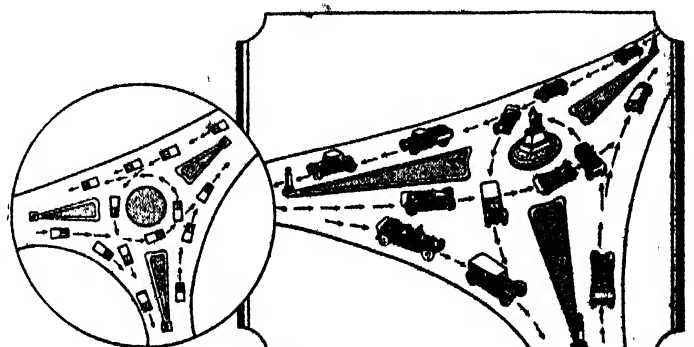
EXPECTED VERSUS UNEXPECTED

It is usually in the case of left-hand turns that accidents happen. Through traffic drivers can judge quite accurately what the other driver will do, except when the other driver turns left unexpectedly and in the wrong manner. Then accidents often will happen, as is illustrated in the drawings on this and the two preceding pages. As shown above, cars making right-hand turns are usually safe



TRAFFIC DISORDER

Figure 8: At this point, traffic intersects at sharp angles. Four policemen are required, and still there are frequent accidents



TRAFFIC ORDER

Figure 9: The corner shown at the left has been equipped with beacons and three triangular areas. Safety is thus increased

The Month In Medical Science

A Review and Commentary on Progress in the Medical and Surgical Field

By MORRIS FISHBEIN, M. D.

Editor of the Journal of the American Medical Association and of Hygeia

Sodium Nitrite Treatment of Seasickness

THE remedies for seasickness are almost as numerous as ships upon the sea. They vary from the old time "Mothersill's seasick remedy," which is essentially a sedative known as chloretone, to the use of tight bandages about the waist or cotton stuffed in the ears. Recently from two independent sources came the suggestion of a new remedy which it appears has been established as having merits.

Doctor Sellheim of Leningrad wrote to the *British Medical Journal* in February to the effect that he had found that single-drop doses of 1 percent solution of glycerol trinitrate (nitroglycerin) had kept one patient

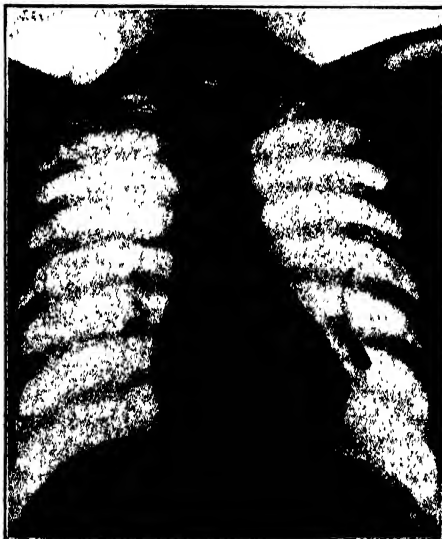
the method used to test aviators, could be relieved of the condition by small doses of sodium nitrite.

One of the investigators tested the method on a trip returning from

course, be tested out on a much larger scale before its limitations can be accurately defined.

Removal of Bullet from Lung by Magnet

IN order to be affected by a magnet, a substance must be composed in part at least of magnetic iron, steel, nickel or cobalt. In the clinic of Chevalier Jackson in Philadelphia, 1900 inhaled or swallowed foreign substances have been removed from the air and food passages by modern scientific methods. These include chiefly the passage of an electrically lighted tube through the windpipe or the esophagus and the picking up of foreign substance by a specially devised forceps.



THE BULLET

An X-ray photograph showing the position of the bullet in the lung of a war veteran

from becoming sick and that a woman who was extremely seasick while sailing on the Black Sea was able to take dinner 20 minutes after swallowing a small dose of nitroglycerin. Moreover, many other patients were protected from seasickness or cured of it by two drops of 0.5 solution of nitroglycerin placed on the tongue.

About the same time two investigators in the University of Chicago School of Medicine announced that they had worked out a system of control involving the use of sodium nitrite, a drug with the same effects as nitroglycerin. They had observed that a person who demonstrated the usual symptoms after twirling in a chair,



BULLET DISPLACED

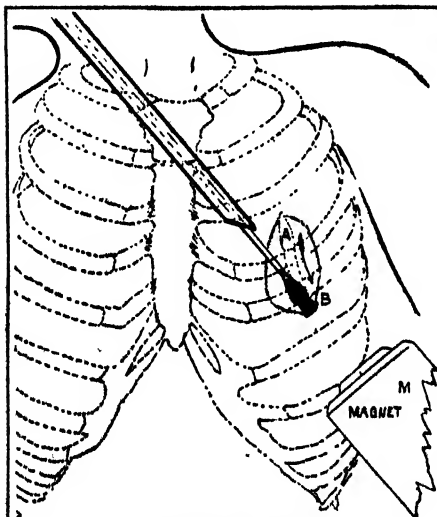
Bronchoscopic forceps caused displacement of the bullet to upper part of the cavity

Europe, when sixteen persons on the boat were seasick. Eight of the persons were given, every two hours, a dose of from three to five grains of sodium nitrite. The other eight were given merely the usual measures. Practically all of the persons who were given the nitrite were freed of their symptoms within four hours, and did not suffer from any recurrence of the symptoms. The method must, of



SIDE VIEW

Bullet was imbedded in an abscess cavity in the lung, and could not be reached readily



MAGNET IS USED

The magnet, M, was used to move the bullet from A to B where it was grasped by forceps

More than 90 percent of foreign bodies cannot be affected by a magnet. In a recent case a Canadian suffered severe symptoms from a wound sustained in 1918. An X-ray examination of the patient showed a bullet about one and one quarter inches long in the lung. A tube was inserted and passed through the main windpipe into one of the smaller branches, but the bullet could not be reached by forceps. Then a magnet was used over the outside wall of the chest by which the bullet was jerked down to a point where it could be reached with the forceps. Here by combination of two modern scientific methods the life of a veteran was saved.



PERHAPS RELATED

A Bogenah Indian of Chifiqui, perhaps related to the bearded Indians of Bolivia

IN our last issue, Mr. Verrill told something of his explorations in South America, and of the tribe of bearded Indians found there. He also described the perils of travel in the jungles, and presented a thrilling word-picture of the dangers of water travel through the wilderness. In the following article he continues his discourse, giving his reasons for adhering to the diffusionist theory to account for the presence of the bearded Indians of South America.—*The Editor.*

PRACTICALLY everything that lives is food to the bearded Indians. Their menu is most varied and includes worms, grubs, insects, lizards, et cetera. Fire is made by rubbing two sticks together and is kept burning perpetually. Cooking is more of a name than a reality, and food is usually eaten half raw, in fact the rawer the better as long as the meat is dead.

Perhaps the most remarkable feature of the tribe is the fact that they have remained so totally distinct from all other tribes and have not apparently mixed with any other race. They appear to be completely isolated in customs, dialect and physical characters, the remnant of some primitive ancient race which has remained unchanged and at a complete standstill for countless thousands of years. In this respect they are much like the Bogenahs of northern Panama and the Bogsas of the interior of Brazil, both of whom are possibly common offshoots of the same race as that from which the bearded-Indian stock sprang.

Both the Bogenahs and Bogsas are small, almost pygmies in fact; both are exceedingly primitive, both live like beasts, subsisting upon anything

that by the wildest stretch of imagination can be classed as food; both lack fixed homes, or villages, and both are renowned for their ability to track game and to follow a trail by scent. Both of these tribes possess beards which are heavier than is usual among Indians, and the physical appearances of both are totally unlike other Indians.

IN both cases, also, they are surrounded by superior tribes who dominate them, and yet they have retained their peculiar characters so steadfastly and completely that instead of learning the dialects of their neighbors they have forced the latter to learn their own tongues in order to communicate with them. Moreover, the two are so similar in many ways that one cannot help feeling that they are closely related, although separated by thousands of miles, while the names Bogenah and Bogsas are phonetically so similar that they might well be local variations of the same word. At all events they are quite distinct from all other known races of Central and South America and in some respects seem to bear such a resemblance to the bearded Sirionos that they might well be offshoots of the same original stock.

All through the interior of Peru and Bolivia are many little known and interesting tribes who do not appear to be related to the better known Quichuas and Aymarás whose ancestors reached high stages of culture and civilization, culminating in the Incan Empire. Some of these possess the typical Indian characteristics facially and otherwise, while far more might well be natives of the South Seas.

The same holds true of the better-known Andean and desert tribes. Among the Aymarás and Quichuas individuals of the so-called Mongolian type are common, but by far the greater number are of the Oceanian type which would be exactly what we might expect if the original stock had migrated

Who Are the Mysterious

Many Scientists Believe that the Cultures of from the Old World by Oceanic Pacific in Canoes—

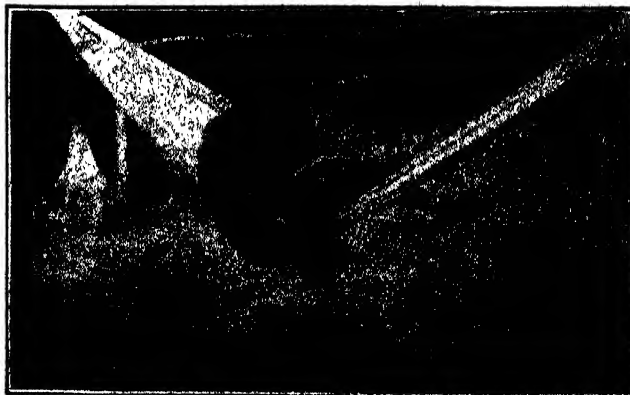
By A. HYATT
Museum of the American

from some Pacific archipelago and later mixed with the more northerly tribes who may have come originally from central or southern Asia or might have wandered southward from the northwest where Mongol migrations are known to have taken place.

Even today it would be an easy matter for any large South Sea Island canoe or catamaran to cross the Pacific to South America. And we have no reason to think that at some time in the past there were not large archipelagoes in the Pacific which formed a series of oceanic stepping-stones from west to east. In fact, according to Dr. Thompson who made an exhaustive study of Easter Island, such an archipelago existed in comparatively modern times. It is not unreasonable to assume that the supposed subsidence of these long-lost islands forced the inhabitants to seek new homes in America.

THAT there was communication between the west coast of America and the Pacific islands has been indisputably established. In excavating prehistoric graves on the coast of California, expeditions from the Museum of the American Indian, Heye Foundation, found specimens of axe and adze heads from Hawaii and other mid-Pacific islands.

It was largely to search for traces of prehistoric cultures which might bear out this theory of an Oceanian origin of the South American races that I made my most recent expedition into the interior of Peru and Bolivia, for there, if anywhere, where ruins, graves and mum-



INDIAN WOMAN OF THE BRAZILIAN BORDER

She is weaving an apron of beads on a primitive loom which is placed in front of her. The art of weaving is widespread

Bearded Indians?—II

Central and South America Were Brought Invaders Who Crossed the South The "Diffusionist" Theory

VERRILL

Indian, Heye Foundation

mies of prehistoric peoples are so numerous and so perfectly preserved, one might expect to find such indications.

Although countless scientists and others have dug and delved among the ancient remains, and although innumerable works have been published in regard to them, yet the surface has not been scratched, and hundreds, even thousands, of ruined temples, forts, cities, buildings and cemeteries have never been studied nor have they even been seen by white men or, for that matter, by other natives. Here, hidden under the debris of ruined temples or palaces, or buried in the graves with the mummified dead, may lie the material which will set at rest all questions as to the origin, the identity and the history of the long-dead races who reached astounding heights of culture and civilization and vanished and were forgotten centuries before the coming of the Spaniards.

AT any moment most astonishing discoveries may be made which may completely upset our ideas of prehistoric man in America. Within the past three years two immense prehistoric cities have been discovered in Peru, close to the thriving port of Pisco and the sea, and my own discovery of an undreamed-of civilization of extreme antiquity in Panama was another proof of how little we really know of these early American races.

One of the main objects of my recent expedition was to compare certain remains of Peru and Bolivia with those

of the Coclé culture of Panama. Much time was spent at Ollantaytambo, Machu-Picchu, Pisac, Viracocha, Rumiccola, Marcapata and Tiahuanaco.

The latter ruins, which are probably the oldest known in South America, are so strikingly like the Panama remains in many features that I feel convinced that they were the work of the same race or of races very closely related. The rows of huge, roughly-hewn stone columns are identical in arrangement and form.

SO too, are the alternate rows of stone images or idols, as well as the monolithic corner stones of the immense rectangular areas apparently used as temples. Certain figures and forms on ceramics and sculptures from the two localities are identical, and it seems scarcely reasonable to assume that two distinct races thousands of miles apart should have by chance developed so many features so amazingly similar.

In many respects, however, Tiahuanaco is totally different from anything yet found in Panama. In the latter country, as far as is known, there are none of the massive buildings composed of stupendous blocks of stone, some weighing over 100 tons, which are such a prominent feature of Tiahuanaco. Neither are there any of the monolithic square gateways or portals, nor the mathematically cut geometrical sculptures. But all of these might be due to environment or a higher development of the same culture.

Perhaps my most interesting find at Tiahuanaco was the discovery of two

huge stone wheels, each over six feet in diameter and about 18 inches in thickness, and with centers pierced for axles. Hitherto it has always been thought that the wheel was unknown to American aborigines, and its absence has often been used as an argument in favor of the extreme antiquity of the races and as against their Asiatic origin. But if the stone wheels of Tiahuanaco were actually used as



INDIAN AND BLOW GUN

This is a forest Indian of a neighboring locality—not one of the bearded Indians

such, it disproves this assumption and also solves the mystery as to how these prehistoric people transported immense masses of stone for such long distances. Slung to axles between these huge wheels, whose thickness would prevent them from sinking into sand or earth, enormous blocks of stone could be transported for miles with little difficulty.

It may be argued that these wheels are not of prehistoric workmanship but are of Spanish origin and were used as mill wheels or *arastas*, but the evidence against this is very strong. I could find no records or traditions of Spanish mill-wheels used in the vicinity and I can hardly see why there should have been, as there is nothing, and as far as is known there never was anything, to be ground in the district about Tiahuanaco.

MOREOVER, it would have required a vast amount of labor for no reason whatever to have carried these huge stone disks up the hill to the ruins where they lie, one of them buried under the gigantic masses of fallen masonry.

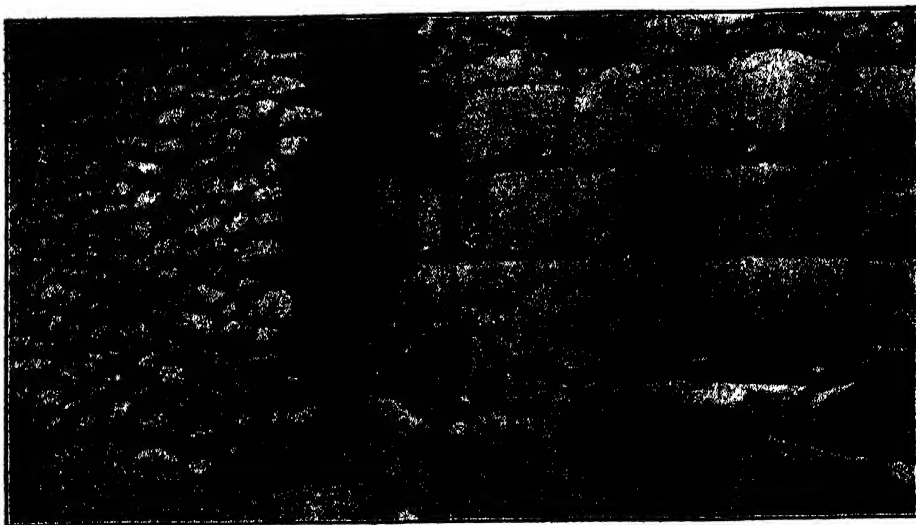
Finally, they appear to be of the same type of workmanship as the other cut stone work. Strangely enough, two similar stone wheels were found buried in the earth while excavating the Coclé ruins in Panama. At the time I dismissed these as being Spanish *arastas*, although there seemed no reason for a mill ever having been used in the arid non-mineralized district. But in view of those at Tiahuanaco I feel convinced that the stone disks at Coclé were also used as wheels for transporting the stone monoliths of the prehistoric race.

Unfortunately Tiahuanaco, which is one of the most interesting and scientifically valuable ruins in South Amer-



WAS THIS STONE DISK A WHEEL?

One of the strongest arguments against the diffusionist theory has been the fact that the wheel was unknown in the New World



PREHISTORIC WALLS AT CUZCO, PERU

The inner, pre-Incan wall is composed of blocks weighing several tons and, without cement, they fit to a knife blade's thickness. The outer wall is Incan work of poorer quality

ica, has been woefully and inexcusably destroyed by vandals, natives and government contractors. Tons of carved sculptures, images, columns and stonework were broken up to be used as filling for the railway bed. Innumerable portions of the finest worked and carved stone have been used by the natives for building their own miserable houses, and some of the most valuable portions and finest statues have been used as building material for the ugly Spanish church in the village. In addition, treasure seekers, souvenir hunters and vandals have dug, broken and destroyed on every side.

Still a vast amount of material remains intact and the largest ruins have never been thoroughly examined nor excavated. When the buildings were built the massive blocks of stone were all locked together by means of huge metal staples and bolts let into the stones. The beautifully cut grooves and holes which held these staples are still everywhere visible, but not a staple can be found in any of the blocks above the surface of the earth.

AN interesting discovery was that some if not all of these metal fastenings were of silver, for a native I met had one in his possession. No doubt the first Spaniards to find the ruins looted them of all the precious metal but the chances are that many of the blocks hidden beneath the accumulated debris of thousands of years still bear the massive silver staples that served to bind the stones together in the past.

In the district about Tiahuanaco, as in most of the trans-Andean and Andean regions of Bolivia, the Indians of the present day are Aymarás, whereas in Peru they are Quichuas. In both cases the races are divided into many subtribes with quite distinctive habits, cultures, arts and physical characters. Such are the Collas of the Aimará race

who inhabit the bleak mountain area on the eastern side of Lake Titicaca. Of all the Aimará tribes the Collas have been the least influenced by the white man's civilization and they still retain many of their own customs and arts. A very large collection was obtained from the Collas as well as from the Yungas, a tribe of totally distinct stock inhabiting the mild, fertile trans-Andean valleys between the mountains and the tropical forested area.

IN the Yungas district, even when beyond the outlying settlements and roads, traveling is by no means difficult, dangerous nor unpleasant. The country is delightful, the climate that of perpetual spring, and the Indians are clean, friendly and hospitable, with an abundance of cattle, sheep, poultry and vegetables.

But I have never experienced greater discomforts, nor have I suffered more from cold, than when in the district of the Collas. Here, at an altitude of from fourteen to fifteen thousand feet, one is constantly exposed to chill, biting winds blowing across more than 100 miles of perpetually ice-clad mountain peaks averaging over 20,000 feet in height. Blizzards are frequent, freezing rain falls without warning, sleet and hail come in blinding squalls, and even when the sun shines the temperature is scarcely above the freezing point.

The only accommodations are the miserable, filthy, vermin-infested hovels of the Indians—tiny, windowless huts of piled-up stones thatched with grass and inhabited by anywhere from three to six Indians and as many burros, pigs, fowls and flea-ridden curs. The only food obtainable from these Indians is crushed maize, a little hard wheat, frozen potatoes and occasional eggs or fowls. Sometimes one may secure air-dried strips of llama or bull meat which is as hard, rancid and tough as rawhide. Or if one happens

to be near a lake or stream, wild ducks and snipe sometimes may be secured.

The only fuel is llama dung, and as water boils at a low temperature it is next to impossible to cook anything by boiling. To boil or roast food over a llama dung fire renders it inedible even to the Indians.

One cannot enquire too closely as to the ingredients of some of the weird dishes offered by the well-meaning Collas. On one occasion, after dining on a sort of stew which tasted unusually good, I learned that it was made of unborn llamas, while another time I made a good meal on cows' udders.

BUT despite all this, despite the bitter cold, the hardships, the lack of all comforts in this bleak land, it possesses its good points. The scenery is inexpressibly grand and magnificent, especially at sunset when the endless ranges of the highest Andes gleam in scarlet and purple and the vast glaciers are transformed to sheets of rose and gold. The Indians in their gaudy ponchos and bright colored mantas are colorful and picturesque. A herd of wild vicuñas, the fleetest-footed, most graceful creatures on earth, is a sight worth going far to see and there is much in the way of wild life to interest the naturalist at every turn. Majestic condors wheel constantly above the snow-capped peaks or perch on lofty pinnacles, viscachas gaze at the traveler from the mounds above their burrows: finches, larks, pipits and scores of other birds twitter and trill even at the verges of the snow fields, and big partridge-like gallinaceous birds whirr up from among the lava-strewn slopes.

Best of all perhaps, there are no insect pests. Neither flies, ticks, gnats nor mosquitoes exist in this cold, rarefied atmosphere, but personally, were I compelled to choose, I would take the steaming tropical jungles—rapids, ants, ticks and all, in preference to these bleak, wind-swept, frost-bitten heights.



BEAST OF BURDEN

Indian women do the work; the men are too fully occupied with important thoughts

"Movie" Illusions— Their Creation



P and A

SOUTH SEA WAVES

On the beach, off to the right, scenes in a South Sea island production are being enacted. Since this is being "shot" on the banks of the Los Angeles River where it passes the First National Studio, obviously waves were needed. A number of men juggle these see-saws, and wild, wild waves boom on the other shore

SPIDERS GALORE

No, Aileen Pringle doesn't have a colony of pet spiders in a cage to make these filmy masses of webs for "haunted houses;" she's holding the mechanical spider which can cover a square foot of surface in a minute. Tiny streams of liquid rubber flow out, solidify in the air, and are blown by an electric fan



International Newswood



P and A

VIEWING a modern motion picture in the theater always found just around the corner, one often experiences a feeling of emotion mixed with a sense of puzzlement and wonder. The emotions engendered by the story as it flashes on the screen cannot down the desire to know how certain photographic effects are produced. We wonder about the storms—how they are made and where; whether the Sahara Desert, African jungles, the streets of Paris, or other scenes shown, are real or only "props;" or, perhaps, how the hero can survive the flames of a burning house or a dive from high cliffs. The photographs on this page illustrate some of the legitimate "tricks" of the "movie" makers which serve to indicate how other effects may be explained



P and A

ON WITH THE DANCE

Left above: The director wanted to show us the facial expressions of Lloyd Hughes and Mary Astor as they danced about the floor, so this floor-level platform was built for dancers, camera, and lights

TOWN TO BE DESTROYED

Above: On a deserted bank of the Sacramento River this town, complete with stores, factories, warehouses, and a large population, was built to be destroyed by an airplane propeller cyclone—the climax to a Buster Keaton comedy

SLIDE, CLOWN, SLIDE

In "Laugh, Clown, Laugh," Lon Chaney makes a thrilling slide down a cable over the heads of a theater audience. This parallel tower was built to get action close-ups. Herbert Brenon is directing



International Newswood



FULL SPEED AHEAD OVER THE CONCRETE SECTION

When the section was placed in service, trains moved slowly, but speed restrictions were gradually modified, and finally removed altogether. Inspections were made at regular intervals

Is Concrete Better Than Cross-ties?

Test Section of Rigid Roadbed, Used a Year, Shows Superiority Over Ballasted Track

By F. D. McHUGH

THERE has been much discussion regarding the feasibility of supplanting wooden railroad cross-ties by concrete slabs and several experimental roadbeds of concrete have been constructed. Little success has been attained hitherto, however, and a great difference of opinion still exists among railroad men on this score.

Desirability of resilience was the argument to which opponents of a change tenaciously clung. To them, a concrete slab was out of the question: the train impact on a rigid roadbed would batter the rail flat; jarring would wreck rolling stock; and the noise would be unbearable. Then too, they said, frost and settling embankments would throw tracks out of alignment and destroy the foundation.

Now, however, a design for a rigid roadbed has not only been worked out to the last detail, but has been tried after actual construction for a year and found to be satisfactory. This experiment was carried out on a quarter-mile stretch of railroad on the Pere Marquette, following close study of the problem by Frank H. Alfred, the far-seeing president

and general manager of this railroad.

The Pere Marquette's test section of concrete slab roadbed was finished in December, 1926. It is located at a point convenient for frequent observation, on a 0.1 percent grade between Detroit and Plymouth. At the time of its construction, the daily traffic on this track consisted of seven scheduled passenger trains, seven scheduled freight trains, four regular switching movements, and about two extra freight trains. The heaviest locomotives used were of the Santa Fe type,

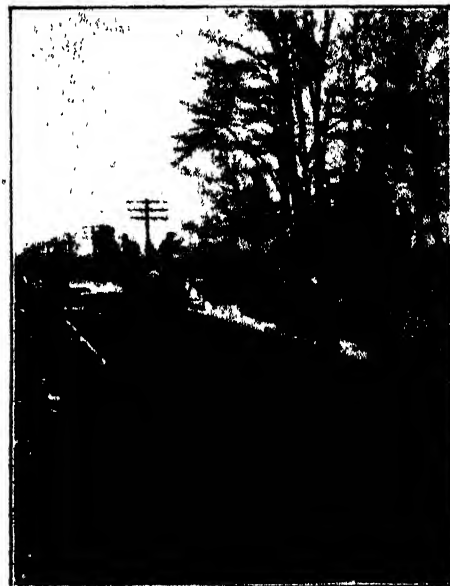


TRUSSES, CHORDS, STIRRUPS

All this steel-work is below surface of the concrete except the stirrups which extend above to hold the rail bolts

weighing 321,000 pounds, 264,000 pounds of which is on five driver axles.

Thirty-four slabs, 39 feet long, 10 feet wide, and 21 inches thick, make up the quarter-mile section. Imbedded in the concrete, in addition to reinforcing rods, was a light fabricated steel truss under each rail. Brace frames and adjustable tie rods were connected between these trusses at intervals. The trusses were fabricated with upper longitudinal chords of one-quarter-inch by four-inch steel,



ASSEMBLING REINFORCEMENT

Trusses and reinforcing rods are being assembled here. The concrete mixer is shown

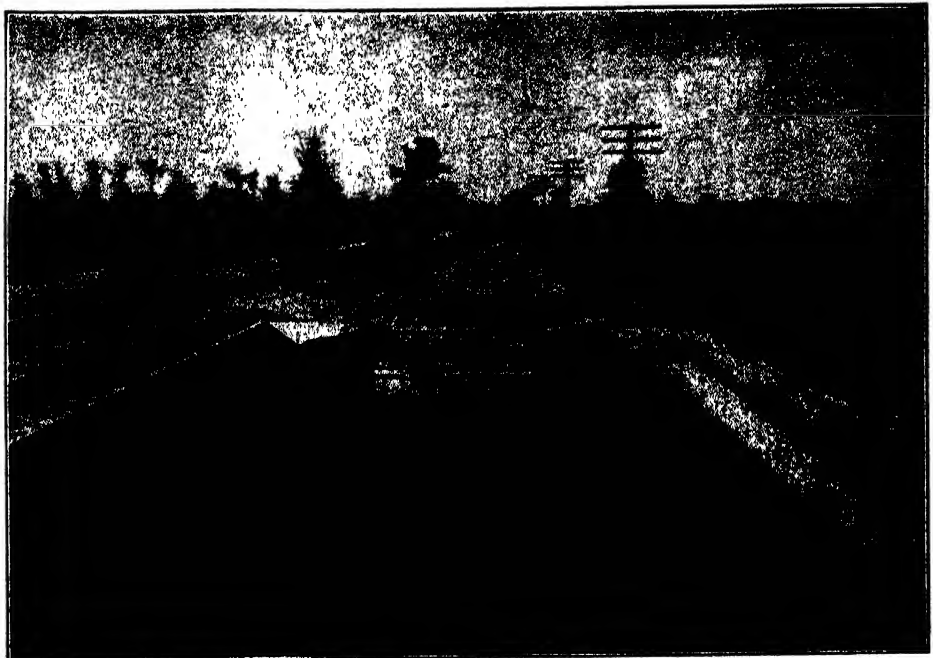
mounted vertically, to which steel stirrups were attached at intervals of 27 inches. The rails were fastened to these with clips and bolts, the rails resting directly on the concrete except for slight insulation which was necessary because of the block-signal system.

During the construction, all traffic was routed over the adjacent track. Ballast was removed only to the bottom of the old ties, thus making the concrete slab 15 inches higher than the parallel roadbed, incidentally allowing better drainage. Fabricated steel was then assembled, and alignment was assured by using transit and level. Concrete was prepared in a small mixer and delivered in concrete buggies. After flotation of the surface, the rail bearings were carefully troweled, and minor irregularities later removed by rubbing with carborundum bricks. The bed was then cured by keeping it covered with moist sand for seven days, and the first train ran over it three weeks after construction.

After a year's hard service, the concrete roadbed is in excellent condition, shows no disintegration, and the rails are not unduly battered. Levels have settled slightly but uniformly, and only four slabs have minute cracks.

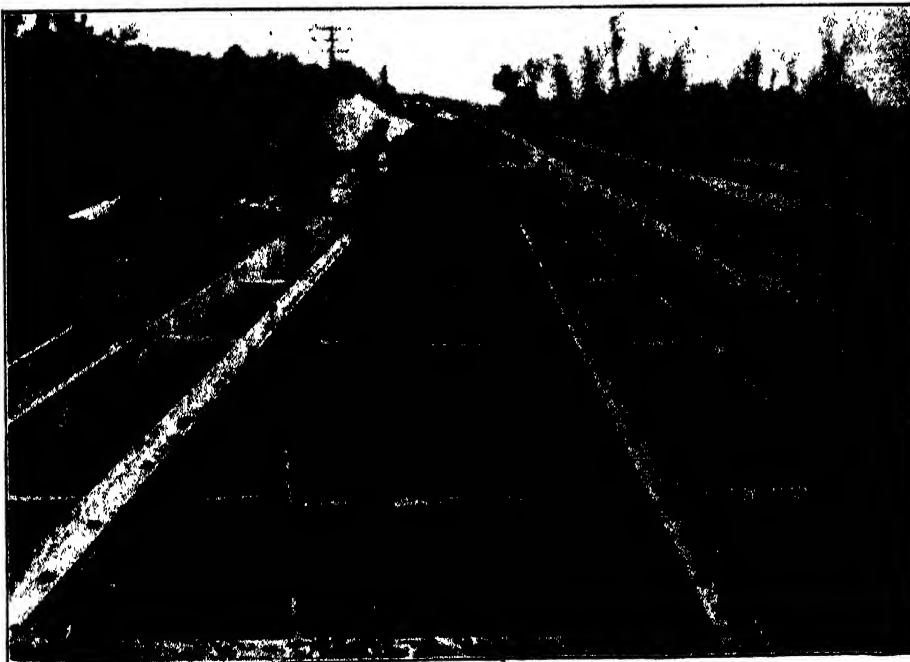
Trains now ride as smoothly over the section as when it was built and, although the train noise is different from, it is no greater than, that made by a train on an ordinary track. There is no dust nor any click as wheels pass over a joint.

Paul Chipman, valuation engineer of the Pere Marquette, says in his report concerning this experiment, "One feature, the importance of which was realized when this section was built, has received added emphasis from our experience. This feature is the importance of having as close a contact as possible between the base of the rail and its support, and of maintaining this close contact by keeping the bolts, which fasten the rails to the roadbed, tight. It is important to reduce both vertical and lateral movement to the lowest possible limits." This statement, based on experience, nullifies the arguments of those who would place cushioning material between the



CHECKING ALIGNMENT

After all steel reinforcing had been assembled and the concrete forms had been erected ready for the pouring of concrete, a transit was used to check carefully the gage, alignment and level of the trusses and stirrups which hold the rails



odic tightening of bolts and normal replacement of rails.

The success of this experiment augurs well for the future of the rigid roadbed and, in many quarters the opinion is that, after further tests, a design will be worked out that will be even more satisfactory. Simple reinforcing rods have been suggested in place of the fabricated steel, and other economies are expected in concrete. Less hammering may mean that smaller rails can be used, and elimination of wave motion may make faster schedules possible. Experience over a period of years only can answer these and other questions that remain, but one has been definitely settled, namely: resilience is unnecessary!

▲ READY FOR CONCRETE

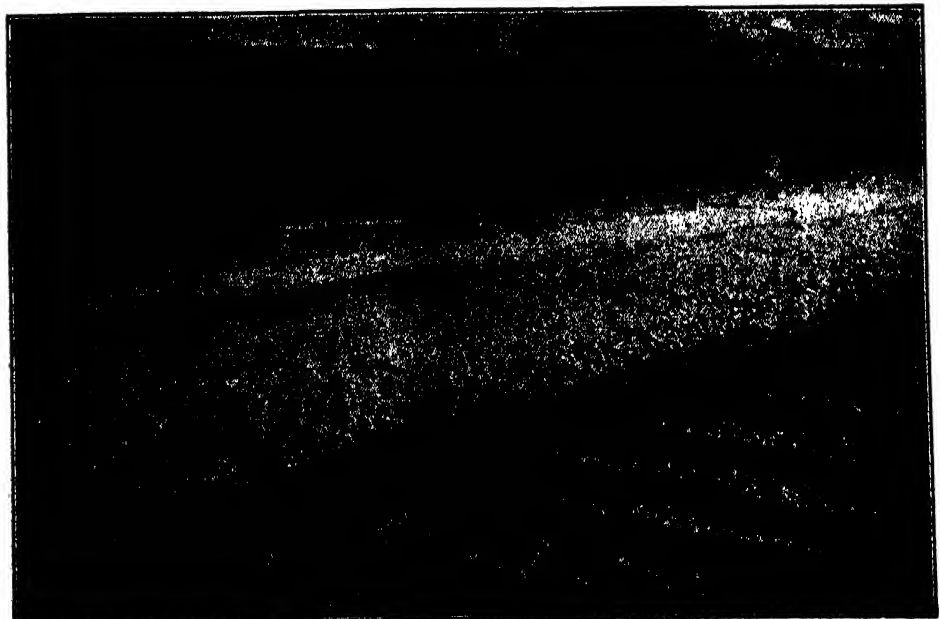
Before pouring concrete on the assembled steel reinforcing, a three-inch by three-inch angle iron was bolted to the stirrups over each truss by means of clip bolts. These angles held the assembly in alignment while concrete was poured

THE COMPLETED ROADBED ➤

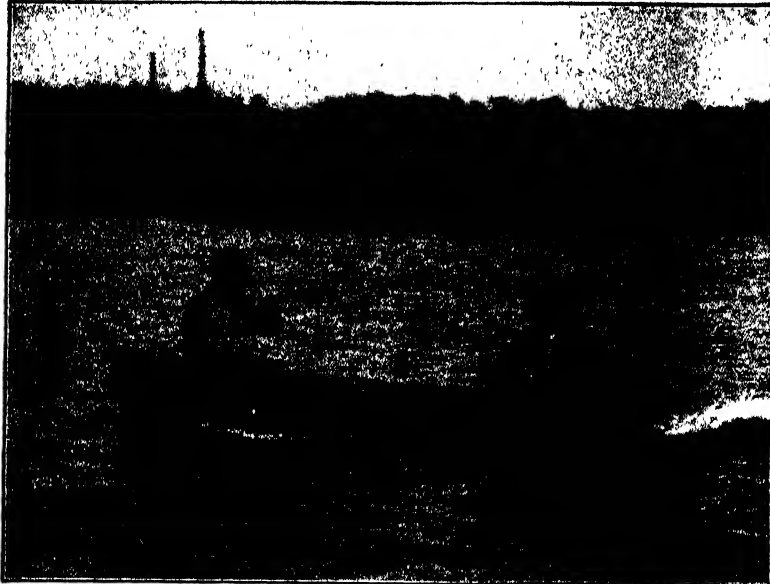
A freight train flashes by on the track with the permanent rigid roadbed. Although the train is going at high speed, it will be noted that there is no evidence of wave motion nor of hammering of roadbed or rail. Shock to rolling stock is, therefore, less than it is on a ballasted track

rails and the slab on such a roadbed.

This test seems to have proved the practicability of a rigid roadbed. It has disproved the idea that hammering of rails would be excessive, and has shown that there is no wave motion in advance of a train. The initial cost of such roadbeds is not prohibitive and maintenance resolves itself into a peri-

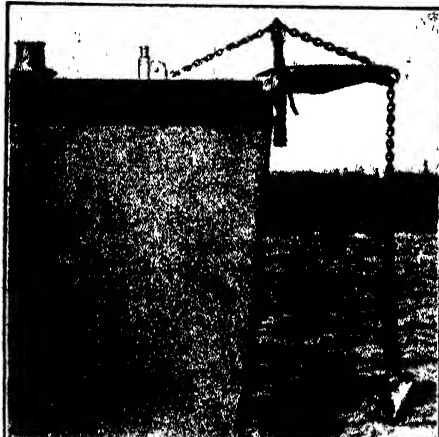


New Boats and Boat Equipment



◀ A FOLDING BOAT

This boat, which folds into a compact bundle 12 inches by 14 inches by five feet, is 10 feet, two inches long and three feet, six inches wide when opened. It is made of solid mahogany sections inside and out permanently in place with heavy waterproof canvas between. It can be assembled in less than two minutes without tools.—Bair and Edgerton Boat Works, Glen Cove, N. Y.

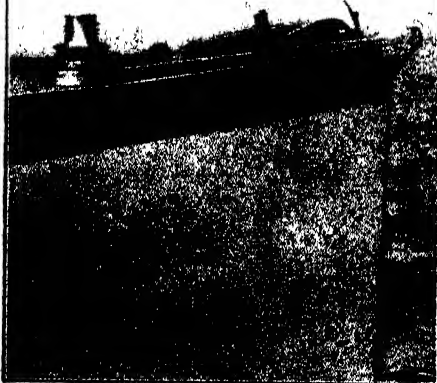


AUTOMATIC BILGE PUMP ▶

Bilge water in a boat equipped with this pump, lifts the floats and starts a self-contained electric motor pump. Can be set to operate constantly or only as water rises.—M. L. Oberdorfer Brass Company, Syracuse, New York

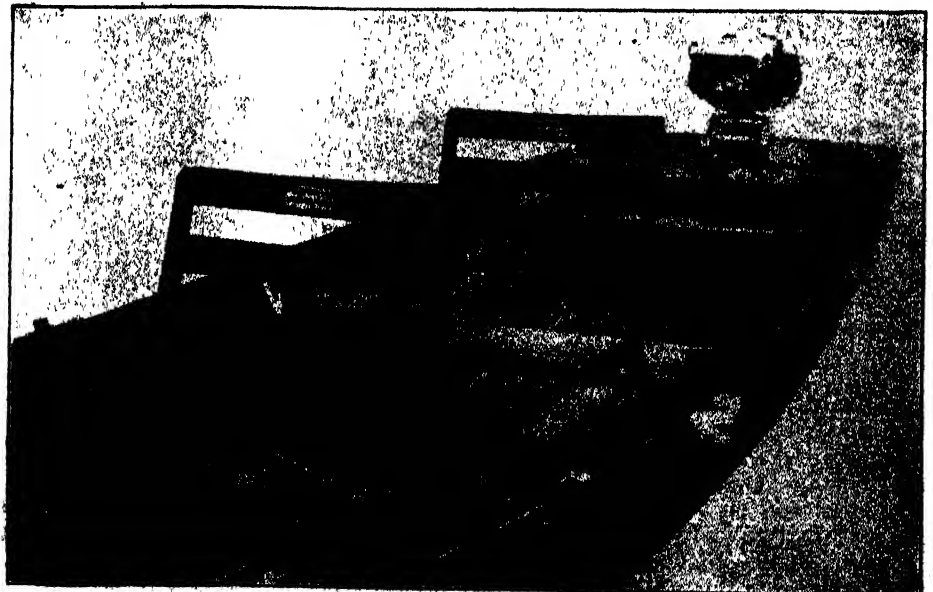
SEAT BACK ▼

Made up entirely of steel, light and adjustable to the most comfortable angle, this folding, portable back rest will fit any standard boat seat. It can be firmly attached in half a minute.—Warner Manufacturing Company, Minneapolis, Minn.

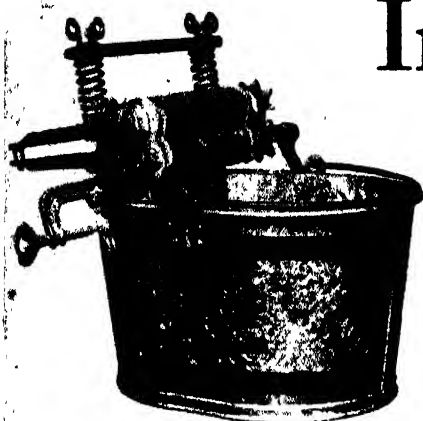


ELECTRIC ANCHOR

Two views of a new anchor which is operated by the touch of an electric button located near the tiller. When down, the anchor chain swings free of the bow on an arm; when up, arm folds back on deck. Requires little current. Can be operated with usual storage battery.—Howard W. Lyon, Inc., 582 Lexington Ave., New York

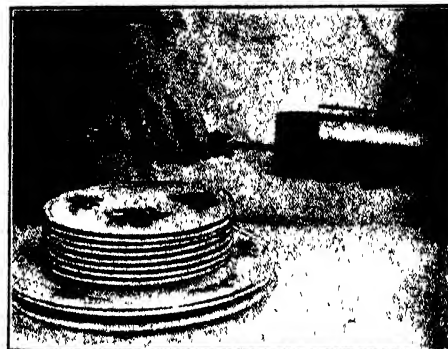


Household Inventions



DETACHABLE WRINGER

Suitable for the small apartment or home where but few things are laundered by the housewife, this new wringer can be attached to a small pail. It saves silky and filmy pieces that would be harmed by twisting.
—*Lovell Manufacturing Co., Erie, Pa.*



DISH WASHER

The familiar rubber sponge has been given a handle and made into a dish washer. When a button is pressed, the handle is lengthened for washing deep glasses, fruit jars, and pitchers.
—*Kristee Rubber Co., Akron, Ohio.*

CAP RIM SMOOTHER

By turning the crank which rotates the cap against the wheel on the lever as shown, it is possible to eliminate dents and nicks in the rim of jar caps, for better sealing.
—*Hug Manufacturing Co., Ames, Iowa.*



WAX ELECTRIC CANDLE

The unique feature of this electrical candle is that it is made of real wax, the wires passing up through the center. The special lamp is made to resemble as nearly as possible the flame of an ordinary candle for its realistic effect.
—*Art Kraft Fixture Co., 320 Adams St., Newark, N. J.*

ILLUMINATED MIRROR

This mirror focuses a diffused yet concentrated light on the face of the user. It has a ball-and-socket joint so that it may be easily adjusted to any angle. It should be especially useful for the man who shaves himself or for milady's toilet.
—*Bull Dog Floor Clip Co., Winterset, Iowa.*



MANY-IN-ONE NURSERY COMBINATION

Here is everything the baby needs—crib, bath, dressing table, clothes drawer, toilet-ware cabinet, and indoor carriage. At the left: dressing table is placed over the

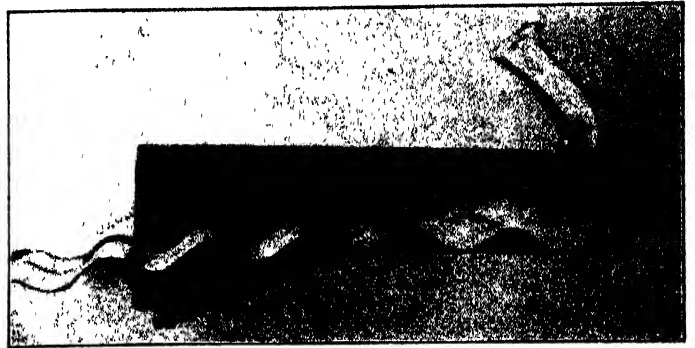
filled tub which is made of rubberized fabric and may be folded. At the right: baby is strapped to dressing table, extended.
—*The Nursery-Crafters, 1032 Jay St., Rochester, N. Y.*

Inventions New



TRACK-LAYING BARROW

A new English barrow which, like the fighting tank, has a wide, linked tread. It can easily be pushed over obstructions, through mud, or over irregular ground where an ordinary wheel-barrow is difficult to handle.—*Roadless Traction Limited, Gunnersbury House, Hounslow, Middlesex, England*



HACK-SAW FOR SHEET METAL

The end of the blade opposite the handle of this new hack-saw is held by a thin stiff blade of steel. The blade's angle allows hack-sawing of long sheets, regardless of width, where it would be impossible to do the job with any other saw.—*Arthur Collier, 453 Brixton Road, London, S.W. 9., England*



AUTOMOBILE ALTIMETER

With one of these neat instruments on the instrument board of his car, the driver can always tell at a glance how high he is above sea level. Can also be set to show the height of one place above another.—*Tycos Instrument Companies, Rochester, N. Y.*



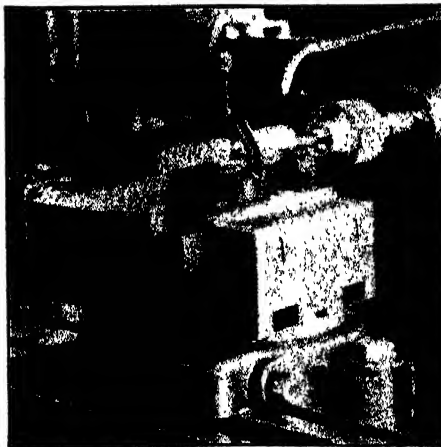
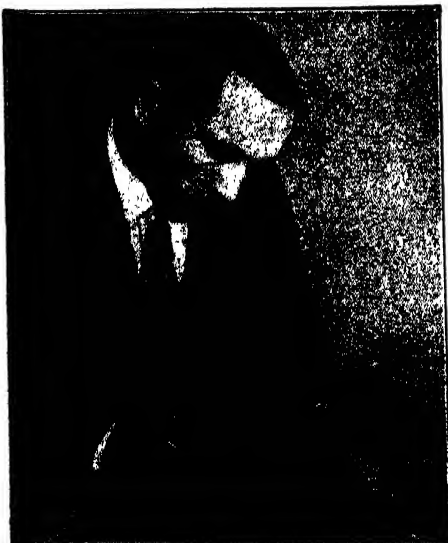
▲ HANDY BLOCK AND CLAMP

For home, work bench, or machine shop. In the illustration above, clamp and block are being used as a vise; below they assist in a difficult machining job.—*Browne and Sharpe Mfg. Company, Providence, R. I.* ▼



RUBBER GOLF TEE

Made of rubber, in the shape of a truncated cone, with each end hollowed out, this new tee is just the proper height for either iron or wood shots. It gives a good support and is so light that there is no resistance to follow through.—*Acushnet Process Company, New Bedford, Mass.*



◀ NEWSPAPER CLIPPER

Essentially, a steel rod bent into a U, having the points tempered and sharpened to blades, this new device is a time-saver. A threaded rod between the legs, on one end of which is a thumb screw, allows adjustment of width.—*Roland Nunes, 18,000 Ventura Boulevard, Reseda, Cal.*



RUBBER PLUG-CONNECTOR

Bang it about, step on it, drop it, and still you cannot break this new connection which is made of solid soft rubber. It is extended in a convenient handle shape so that it can be pulled easily from any slotted plug socket, especially in narrow hanging shades. *The Belden Mfg. Company, 2800 S. Western Avenue, Chicago*

and Interesting



GUNS SHOOT SPOT-LIGHT

Invented by a retired English Brigadier General, this new instructional gun, which is made in several models, uses no bullets; when the trigger is pulled it simply throws a spot-light on the target. Since there is no recoil, the gun is expected to correct flinching. Above: several models are being used on an indoor range. Right: the electrical "cartridge" that makes the contact and flashes the light is being inserted in the breech of an ordinary gun.—*"Flash Spotter" Ltd., 217a Kensington High Street, London, W.8., Eng.*



TIRE HOSE GAGE

When the air chuck on the hose is placed on tire valve, the gage registers pressure of air in the tire. To inflate tire, the handle is pushed forward so that air may pass the gage. The tire air-pressure is tested by pulling the handle back.—*Specialty Manufacturers, Inc., Fort Myers, Fla.*



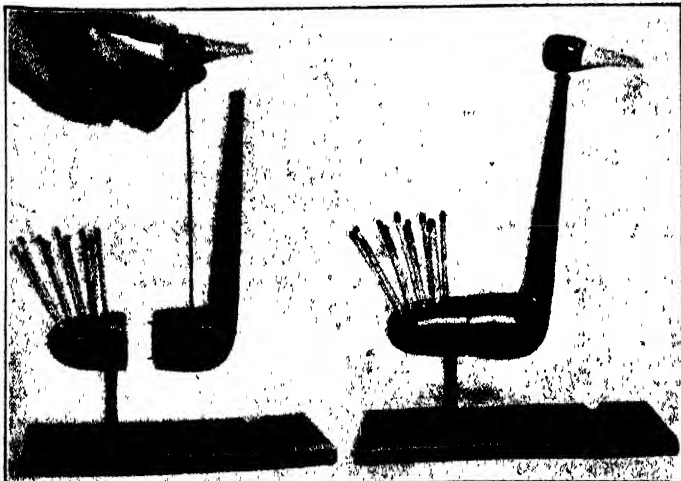
INSIDE SCROLL SANDER

This new sander gets into the corners of intricate patterns such as those cut by jig saw or router; it is adapted to inside or outside work. It has a 15 to 30-foot belt of sanded cloth which runs over a bracket above the table, and a set of pulleys.—*B and V Engineering Service, Shelbyville, Ind.*



EMERGENCY TIRE CHAINS

These tire chains are simple cross chains that snap around the tire and the wheel rim between the spokes. A special gripping arrangement makes it possible to pull out of the deepest mud and yet ride on pavements with but little bumping and cutting of the tires.—*Woodworth Specialties Co., Binghamton, N. Y.*



PIPE SET

This decorative duck is not only novel but also quite useful. The long wire holding the head is a pipe-stem cleaner; the pipe holder is a reamer for the bowl; the back holds a supply of matches; and the base is a neat ash tray.—*Stein and Ellbogen, Chicago*

UNIVERSAL VISE

This new vise, although screwed to a bench, may be adjusted to any position with a simple turn of the wrist so that the workman can see what he is doing. It has a ball-and-socket base.—*The Bel-Kel Mfg. Company, 740 E. North St., Decatur, Illinois*



California's First Oil Well Is Still Producing

*Drilled in 1870, By the Spring-pole Method, the Well
Still Yields About Four Barrels of Oil Daily*

By HERBERT OTIS WARREN

THE enormous oil industry of California had its birth in Pico Canon, near the town of Newhall in Los Angeles County, in 1865, when Ramon Perea, a Mexican deer hunter, followed a trail to the head of the canon and came upon a seepage of sticky, black fluid that was unknown to him. Probably on the spur of curiosity, he gathered a small quantity of it in a canteen and returned to San Fernando to the Franciscan mission settlement.

Doctor Gelsich, a former resident in an oil-producing district of Pennsylvania, was given the canteen by J. L. Del Valle—to whom Perea had given the fluid—and he promptly declared the contents to be petroleum. He lost little time in forming a company and staking out placer claims covering the find under the then existing laws of California.

IT was nearly five years later, however, before a shallow well was drilled at the head of Pico Canon, by the old spring-pole method, and at the time of drilling, between 70 and 75 barrels of oil were produced a day.

The spring-pole system was originally used in digging brine-wells about a century ago, and was quite similar to the spring-board method practiced by the Chinese. The Chinese were among the earliest oil drillers—perhaps the first. History does not record just how many centuries ago these people developed their process, but for 2000 years—down to 1899—it had remained unchanged. Their apparatus was extremely crude when contrasted with modern well-drilling machinery, yet their methods were in principle strikingly like many scientific practices followed today.

The Chinese employed a cutting tool which was suspended in the hole by means of a stout rattan cable, and a spring-board arrangement—the workers giving it the necessary movement. When a coolie jumped upon the board it raised the bit, and when he relieved it of his weight the bit fell and cut its way downward.

A drum with a vertical shaft, around

which oxen traveled in a circle, coiled the cable and lifted the drill out of the hole when it was desired to change tools or bail out the cuttings. The bailer was made of a section of bamboo, which tree also was used for casing, and for tubing and pipe-lines.

To return to the "spring-pole" process: A sapling 40 or 50 feet long was set at an angle of 30 degrees, with the upper end, to which a rope was attached, carrying the bit over the hole.



WELL NUMBER 4

As the well is today, after some 58 years of producing liquid riches for its owners

To give the tool its cutting action all that was necessary was to spring the pole up and down.

After completion of the well, C. A. Mentry was placed in charge of the work as manager and the Pacific Coast Oil Company was later formed.

It was not until 1879 that the first steam engine was brought into Pico Canon to replace the spring-pole well. This engine today is still on its orig-

inal location and in good running order at "California Oil Works Company Well Number 4"—the name the state's first oil well is known by.

Twenty-three years ago the Standard Oil Company of California took over the well and production now averages four and one half barrels of oil a day.

Old "Number 4" is no Lakeview or Mayes. It has never startled the nation with its volume—it has not been much of a factor in California's great petroleum industry as we know it today, yet, while hundreds of wells since drilled have not even a derrick left to mark their one-time location, "Number 4" is still alive, still producing—a working monument commemorating the beginning of petroleum wells in the "Golden State."

Pico Canon is part of California's well-known oil district, Newhall fields, which include Wiley and Elsmere canons. To those not versed in oil locations, Pico Canon would appear to be barren of this rich fluid.

THE usual conception of a typical oil field is a district that resembles a flat waste of sage-brush covered desert, fringed by gently rolling hills. In such territory rock formations and exposed ledges are seldom encountered. This is perhaps a good description of the wells in and around Bakersfield where the land is as level as a table.

But this is not the case with Newhall—for here is rugged mountain country with precipitous canons, jagged rocks and overhanging ledges. It is truly a mountain-lion and eagle country—in fact, both were common there 40 years ago. The topography of the Newhall field is vividly suggested in the following abstract from a report of a geologist, Mr. S. H. Gester:

"The age and structure of the formations penetrated by the wells of the Pico and Wiley fields are the same. In fact, the sharp anticlinal fold, often found to be overturned and severely contorted, is continuous for more than eight miles, extending in a northwest southeast direction through both the Pico and Wiley fields. The strata

of this fold belong to a geological formation known as the 'Vaqueros' and are of lower-Miocene age. Because of the extreme sharpness of the fold, locations for productive wells are limited to a narrow belt along the apex of the anticline—a distance of 100 feet horizontally on either dip of the anticline will often necessitate a depth of 500 feet or more before the same sands can be reached by the drill."

The wells in the Elsmere field are started in a much younger formation than that of the other fields. In the first-named field the strata dip in more or less one direction and therefore the wells are not located in such an anticline structure as those of the Pico and Wiley fields. Some of the Elsmere wells undoubtedly produce from sands of a formation known as the Fernando, while deeper ones may also encounter underlying Vaqueros sands and produce oil from both formations.

Tracing the evolution of drilling equipment brings to light many improvements over the ancient spring-pole method of drilling. The radical departure in drilling methods came with the introduction of the rotary, invented in 1845, but not generally used until about 1900. Twelve years before this, however, in 1888—the rotary was used in the Gulf country. Two strings of pipe were used—one to wall up the hole, and the other, with the drill attached, was rotated inside of it.

IN 1889 it was discovered that a circulation of thick mud pumped through the drill-stem would support the walls of the hole until drilling was completed, in instances when the formation was favorable and the hole not too deep.

This discovery was credited to B. Andrews, Sr., of New Orleans, and is considered to be the most important step in the development of the rotary method. In 1901 Captain J. F. Lucas, drilling near Beaumont, Texas, completed the first oil well drilled by the rotary method.

Men in the oil fields sometimes refer to their companions who handle the rotary as "round-and-rounders," while those who are cable-tool workers are called "up-and-down-boys." And no clearer explanation can be offered than is contained in this slangy phraseology.

The development of the rotary did not supplant the cable tools, for today many wells employ both methods, and in the majority of cases both are utilized before a well is completed.

The home of the rotary was in the Texas and Louisiana fields where cast-iron rotaries were employed. California conditions—where deeper wells are bored—brought about a change in the rotary, and heavier and more powerful machines constructed of steel made their appearance in 1905. All rotaries were chain-driven until 1918, when a

California manufacturer introduced the shaft-driven rotary.

Holes 20 inches in diameter are now started with a rotary—and the weight of the machine required to do this work is nearly three and a half tons. The complete rotary outfit used in the California oil fields weighs approximately fifty thousand pounds.

route that General Fremont came and conquered the Mexican forces then in Los Angeles. The cut is 65 feet deep, and but a few feet wider at the top than at the bottom, where there is room for but one automobile to pass at a time.

One of the men who has watched "Number 4" for 26 years can be found



J. W. GALBRAITH AT NUMBER 4

At the age of 65, this old timer of the oil fields is about to retire. For the last 26 years, he has watched over the machinery of the well, and has well earned his vacation

California oil wells are noted for their depth, and to meet the requirements of the operators, what was known as the "California rig" was introduced. This instrument differs from those used in the east in that it is equipped with a "calf-wheel" for lowering and raising the casing in the hole. The eastern rig has no equipment for handling casing except for driving purposes.

It is truly a long jump from the earliest form of well-digging to the present day methods by which it is possible to take out 600 barrels or more of oil per day.

The trip to the site of the birthplace of the oil industry in California is an interesting one, although some of the road is rough and steep. At Newhall Pass, not far from "Number 4" may be seen an ancient cut through which the old roadway ran. This was known as the Fremont Pass in early California days, and it was over this

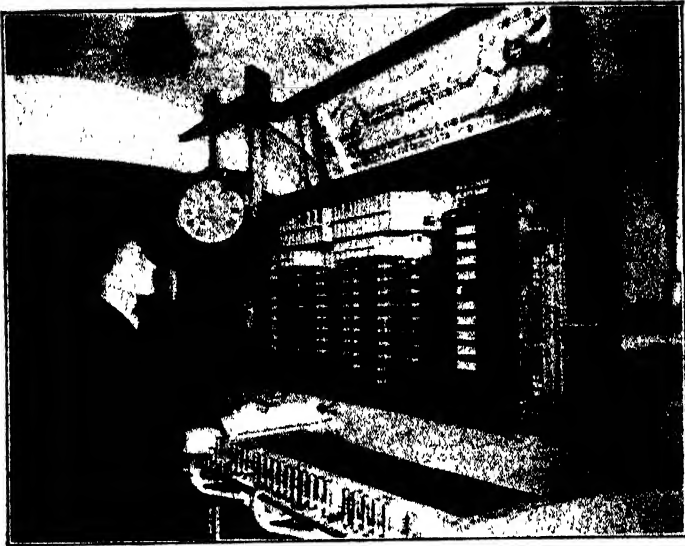
on the lease today. He is J. W. Galbraith, 65-year-old, robust, oil man. He stated that the well has been averaging as good as any on the lease—and the hillsides of Pico Canon are dotted with derricks, the pumps of which are operated from a central power house near the oil well.

Galbraith plans to retire soon and move out into the valley after nearly half a lifetime of daily effort shut in by the hills from any extensive view of the outside country.

That old "Number 4" enjoys a unique position among California oil wells is attested by the fact that more than one million barrels of oil have been taken from the well since 1870.

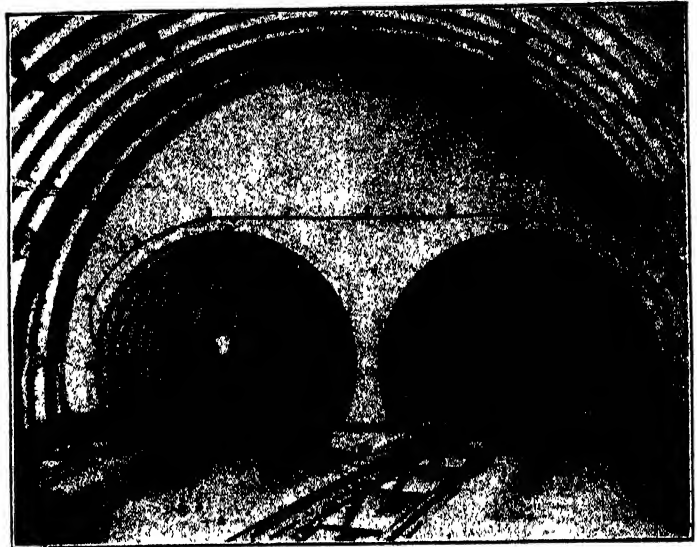
¶ *Traces of an ancient civilization in the southwestern part of the United States have been found along the Mimbres River in New Mexico. Be sure to read the details of the discoveries which will appear in a near future issue.*

London's New Post-office Subway



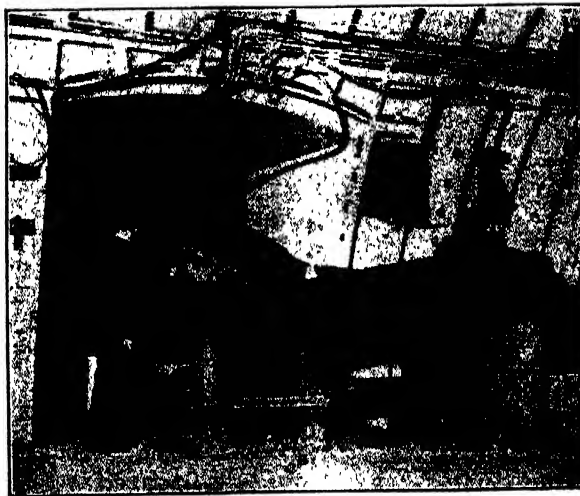
TRAIN CONTROL BOARD

London's newest railway, recently placed in service, is a subway for carrying mail between White-chapel in the eastern part of the city and Paddington in the western part. Built primarily for accelerating the conveyance of letters and parcels through the city, it is the result of plans considered as long ago as 1909. The trains, consisting of one to three cars, each capable of carrying 1120 pounds, are driverless, operation being effected from switch cabins at each station. The tunnel is 50 to 90 feet below the surface. Each station has spiral chutes for carrying mail down, and elevators for carrying it up. From the switch-board shown above, all trains in Mount Pleasant division are controlled. Above the operator is an illuminated diagram board which shows location of trains on all tracks of the division he controls



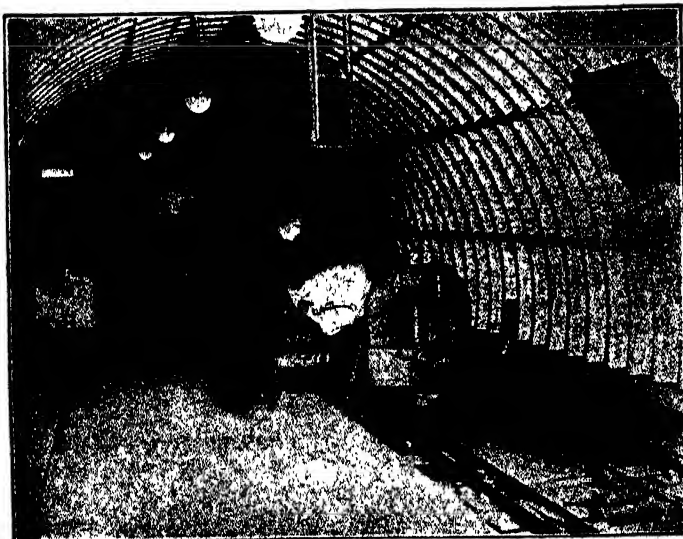
TUBE JUNCTION

View of the junction of two tubes near the Mount Pleasant post-office. Total length of this system is six and one half miles, but it is planned to extend it until ultimately it will form a net-work throughout the city. Its operation is relatively simple: mail bags are loaded on the trains at the General Post-office and Mount Pleasant and then routed to the various post-offices along the line in the driverless cars. The relief that this railway will afford to street traffic will be appreciated when it is considered that 750 tons of mail must be handled daily, and that this railway is capable of making approximately 800 train journeys a day, carrying a total load of 28,000 bags, at an average speed of 20 miles an hour in contrast to five to seven miles per hour by surface carriers. This railway is the first of its kind



BAG CHUTE

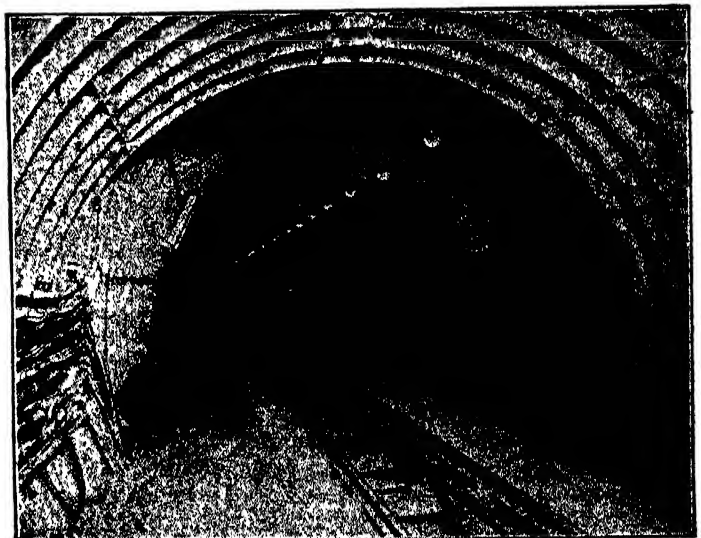
From the post-office above ground, mail bags are conveyed by this chute to the station platform below. To prevent their piling up, a conveyor belt is utilized to carry them to a truck-loading table



International Newsreel

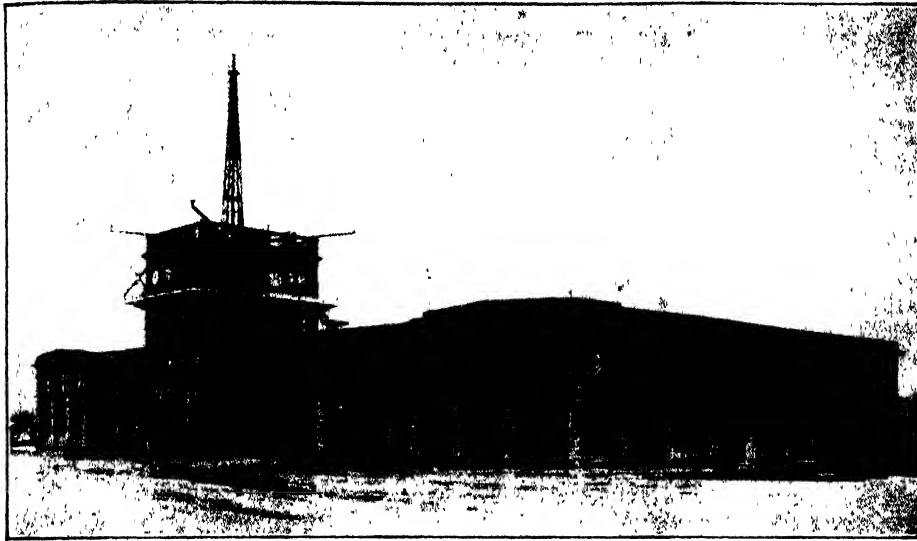
LOADING A TRAIN

Hand trucks carry the mail bags about the platform after they are loaded at the chute. It is expected that this system will effect a saving of about 200,000 dollars annually



MOUNT PLEASANT STATION

All stations were provided with through (express) tracks in addition to platform tracks. Reversing loops were laid out at most stations and the more important ones also have sidings



RADIO CONTROL BUILDING AT CROYDON AIRPORT

The control apparatus of the transmitter, and the receiving instruments are located in the tower, directly under the mast which supports the double triangular direction-finding aeriels

"Passing Boulogne!"

Huge Radio Station at Croydon Serves British Airways

By A. P. PECK

IMPERIAL G-BOZ calling. Imperial G-BOZ calling. Passing Boulogne. Passing Boulogne. Over." And the radio operator at England's huge airport and radio station knows that the airplane G-BOZ has safely crossed the channel and is passing into the flying zone which is under the control of the French.

The Croydon airport is notable not only for the highly efficient and modern equipment for handling aircraft, but also for its complete radio installations,

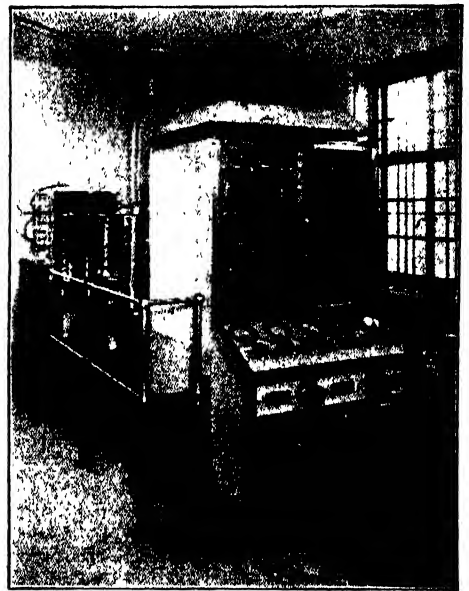
some views of which are reproduced on this page. By means of these, the passage of planes over the regular air-transport routes can be followed as accurately as are the trains on a railroad system. All of the regular passenger planes flying from Croydon are equipped with radio transmitting and receiving apparatus by means of which they can keep in constant communication with the terminal.

The quoted sentences in the first paragraph above serve to illustrate how

the radio operator on a plane reports the plane's position to the airport. "Over" means operator is ready to receive. Upon receipt of the information, a map in the office of the Chief Aerodrome Officer is corrected so that, at any time, the positions of the various planes can be seen at a glance. Tiny metallic planes are held on the map by magnetic attraction.

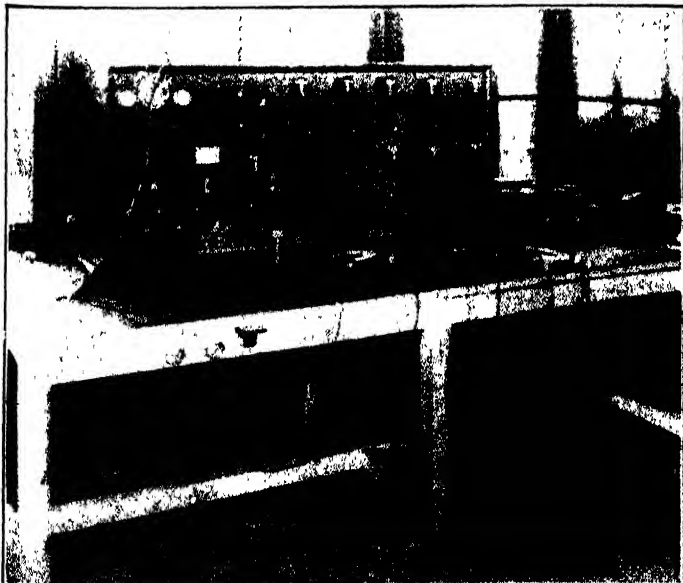
Although the receiving aeriels for regular reception and for direction finding are located at the airport proper, those employed for transmitting are at a point about four miles distant, at Mitcham, so that the tall towers necessary for efficient work will not be a source of danger to the planes.

It is reported that there will be 50 planes a day arriving at or leaving this great terminal airport at Croydon during the coming season.



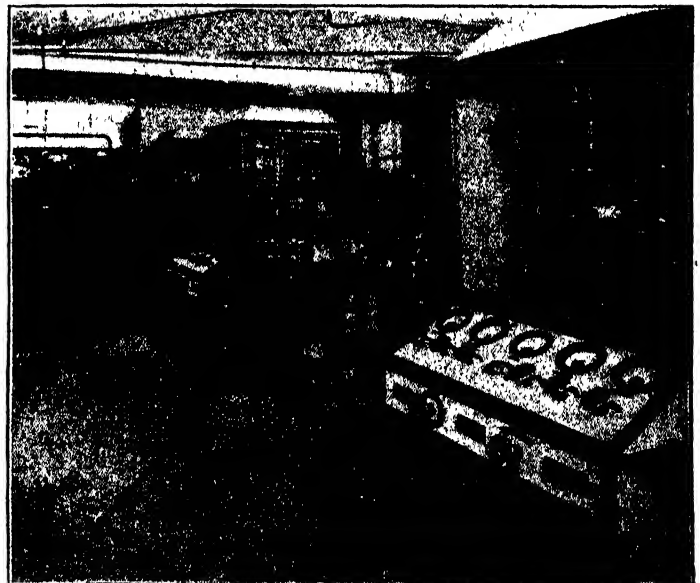
TRANSMITTER

One of the four remote-controlled Marconi three-kilowatt transmitters located at Mitcham



TRANSMITTER CONTROL AND RECEIVER

The huge cabinet at the rear of the table houses the receiving equipment. In front of it are the microphone and code transmitting key



INTERIOR OF BUILDING AT MITCHAM

Here are shown all four of the powerful transmitters, one of which is illustrated in more complete detail in the column directly above

All the World is Seeking Knowledge



In Borneo, Java, Sumatra—throughout the Dutch East Indies—are 138 reading clubs in as close contact with their mother country and Western civilization as steamer and cable lines can make them. Every month each of these clubs gets its own copy of the **SCIENTIFIC AMERICAN**.

In France is a world famed rubber-tire manufacturing plant. Four subscriptions to the **SCIENTIFIC AMERICAN** go to that company, including a personal one to the head of the business.

Out in Rhodesia, South Africa, is the Lonely Reef Gold Mining Company. Its manager is a regular subscriber to the **SCIENTIFIC AMERICAN**.

In Duntroon, Australia, the commandant of the Royal Military College gets every issue of his **SCIENTIFIC AMERICAN**.

In Germany, the head of a great munitions factory; in England, the head of a famous ship yard; in Spain, the Aero Club; in San Paulo, Brazil, the Automobile Club; in the Imperial Palace in Tokyo, Japan—go where you will, subscribers to the **SCIENTIFIC AMERICAN** are found.

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ments, says Mr. Peek, has already been made in California, in safeguarding oil storage tanks from lightning. Several tall rods, placed outside the big reservoirs, provide overlapping cones of protection and reduce the danger to a minimum.—*Science Service.*

Tornado-Resistant Buildings Possible

STRUCTURAL damage to buildings by tornadoes and the loss of life incident thereto, may be avoided or reduced by designing buildings so that they can more readily resist internal pressure, de-

occurs as a result of a difference in atmospheric pressure set up by a tornado between the inside and the outside of a building. The sudden drop in external air pressure produces an internal pressure which frequently results in the blowing out of some portion of the building.

"It is possible to relieve the internal

roof panels arranged to swing outward.

"Such automatic vents could be installed in existing buildings as well as in new buildings. They could be used in all types of buildings, large or small, public or private, in the city or in the country—even to the farmer's barn or poultry house. The practicability of various venting



Air confined behind brick veneer and in the unlined chimneys, caused the face brick to peel off when a tornado passed by

clares L. V. Teesdale, of the United States Forest Products Laboratory.

Property damage to buildings by tornadoes may be divided into two classes—that caused by the explosive effect and that caused by flying debris. The explosive effect, usually the more serious,



Heavy screw jacks between wheels made possible the lowering of the truck for passing under bridges. Note the timber dragged behind the wheels

pressure of air thus set up in a building by providing automatic vents in it," says Mr. Teesdale. "Observations made following the St. Louis tornado last September indicate that from 10 to 15 percent of the outside walls and a similar area in the roof should be vented. There are a number of methods by which this could be done. If a sufficient number of windows or panels were designed so that they would open outward from internal pressure the necessary venting could be accomplished. Special windows equipped with hardware which would work on the same principle as the panic bolts used on exit doors in theaters would do the trick. Hinged panels for use in the spaces between windowsills and floors or elsewhere in the side walls of a building is another venting possibility. Roofs may be vented by automatic dormer windows, by special skylights, or by hinged

methods could be tested in laboratories. This would offer opportunity to work out the most suitable types of vent construction."

Twenty-five Ton Transformer Hauled on Six-wheel Trailer

IN hauling three 25-ton transformers for the Glines Canyon hydro-electric development on the Elwha River of the Northwestern Power and Light Company, Port Angeles, Washington, a six-wheel trailer towed by a tractor was used, the trailer being adapted and equipped with built-in screw jacks at each set of wheels for lowering the trailer bed. In order to get the transformers through one bridge in particular, it was necessary to so manipulate the screw jacks that the bed practically touched the ground. In order to supplement the brakes on the tractor and on the trailer, a piece of timber about four inches square was attached to chains and dragged just behind the four rear wheels of the trailer. This kept the load from running backwards down hill in case it became necessary to stop on an upgrade.

Each transformer was six feet, three inches by eight feet, four inches, and 12 feet, five inches high. Four cables were used to fasten the transformer rigidly to the bed of the trailer to prevent the high load from tipping over.

North Light Is Blue---Not White

SCIENCE has cast another tradition into the ash heap. North sky light, long accepted by artists, engineers, housewives and store clerks as the perfect standard of white light for examining colors, has been found to vary in intensity and color, not only from day to day, but also from hour to hour.

The American Institute of Electrical



One side wall of this house sprang outward at the second floor, but the building remained structurally intact. The frame house is over 60 years old



The new trolley truck with the hydraulic tower in the elevated position. The body of the truck can be used for carrying auxiliary equipment

Engineers is responsible for the latest upset. North sky light is not white, but blue, it was found, and examination of colors under such light exaggerates blues and minimizes reds and yellows. The engineers declare that noon sunlight and not north sky light should be accepted as the standard, and that artificial white light for color discrimination purposes should approximate noon sunlight.—*Science Service.*

Hydraulic Trolley-Tower Truck

A NEW and easy way to reach street lights and overhead wires is afforded by a hydraulic hoist mounted on a two-ton Graham Brothers truck which has a

Detroit, and consists of a rigidly constructed platform with hinged double guard railings with steel brace rods, piston and cylinder gear-driven pump, and transmission power take-off. The cylinder is seven inches in diameter with a one-half inch wall; diameter of the hollow piston rod is five inches.

The working platform is nine feet long and four feet wide and is arranged to swivel and lock securely in any desired position. It is fastened to the top of the piston rod by a heavy collar and held and braced by a ribbed steel plate four feet square. When in lowered position the top surface of the platform is eight feet, six inches from the top of the chassis frame. When in fully elevated position it is 14 feet, seven inches

fully elevated is approximately 16 feet.

The public utility body is built and installed by the Proctor-Keefe Company of Detroit, Michigan.

Largest Railroad Oil Reservoir

THE largest oil storage reservoir ever built by a railroad company, and one of the largest oil containers in the world, has recently been completed by the Southern Pacific in California.

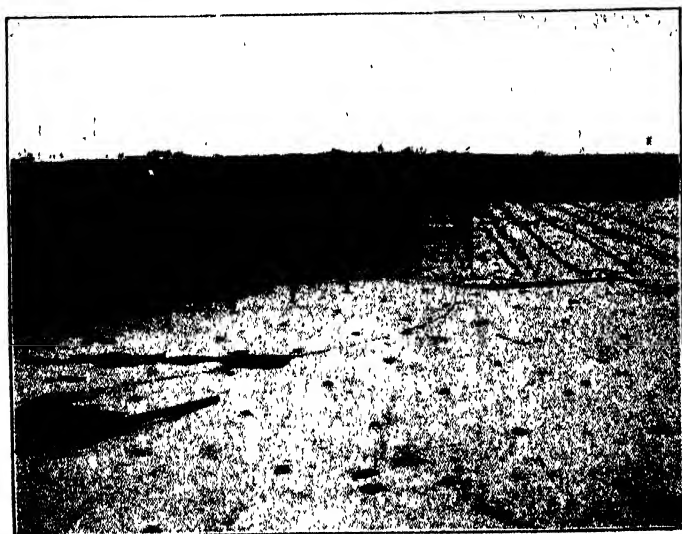
The reservoir has a capacity of 3,000,000 barrels, and is intended to hold a reserve supply of fuel oil for the Company's oil-burning equipment. It is strategically located both with regard to source of oil supply and convenient shipping facilities. Within half a mile are the pipe lines of two of California's largest oil companies, to either of which the reservoir filling pipes can be connected, and the same lines are to be utilized for delivery to the railroad's tank car loading rack near Tracy.

The reservoir is 1085 feet in length, and 490 feet in width, inside the walls, with a depth of 81 feet.

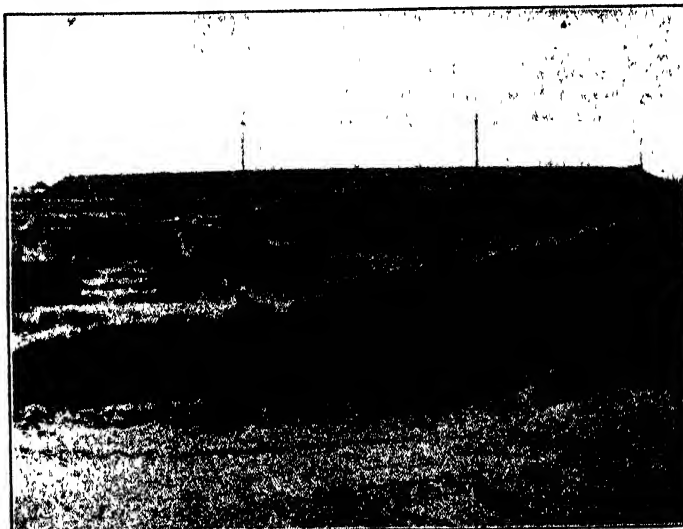
World's Finest Wire Cloth

A WORLD'S record has been established by the Newark Wire Cloth Company of Newark, New Jersey, by making a wire cloth having 160,000 square openings per square inch. It is the finest wire cloth ever made. In other words, it is a "400-mesh" wire cloth with 400 parallel wires per inch of width running each way, at right angles. A piece of the wire cloth slightly more than six square inches in area, or, to be exact, a piece only two and one half inches square, has one million square microscopic openings.

Heretofore the finest wire cloth ever made in the United States has been 325 mesh and it, too, is made by the same company. It is known as Sieve Number 325 by the United States Bureau of Standards, and has been adopted as standard by the



Interior of the new 3,000,000-gallon oil storage reservoir built by the Southern Pacific Railroad. Floor was first completed, and then the entire reservoir was covered



General view of the huge reservoir which is to hold a reserve supply of fuel for the railroad. Standing as it does in a great field, it seems more like a fort of dirt

162-inch wheelbase. The principles involved in the raising and lowering of the working tower are the same as those employed in the hydraulically operated dumping truck.

The tower is built and installed by the Wood Hydraulic Hoist and Body Company,

from the top of the chassis frame. Full elevation is obtained in approximately 50 seconds. Platform can be locked securely at any intermediate elevated point required. Space required back of cab for hoist mounting is 14 inches. The distance from ground to working platform when it is

American Society of Testing Materials. Such fine wire cloth is used principally in the manufacture of testing sieves for the cement industry or others of a like nature.

Ordinary fine wire is not fine enough for 400-mesh wire cloth. It has not the necessary quality—the correct temper—

the required uniformity. The Newark Wire Cloth Company has found it necessary for many years to draw all of its own fine wire, and of course it was an absolute requisite for them to draw the wire for this 400-mesh cloth themselves.

Some 10 years ago the United States Bureau of Standards in their investigation of testing screens, said that it seemed impossible for American manufacturers successfully to manufacture wire cloth with meshes finer than 100 to the inch, and that wire cloth with finer meshes had to be imported. For a long time previous to this, all of the fine wire cloth on sale in the United States came from foreign countries. At that time 325 mesh was the finest made, and 250 mesh was the finest produced in the United States.

Quenching Fires by Catalysis

AFTER man, centuries ago, found he could produce heat and fire by rubbing two sticks together, he immediately had to find ways and means of subduing the monster he had loosed. For while fire gave him heat, it was also very destructive if it got out of his control.

Since then man has "drowned" or "smothered" fires almost universally. In the first method of drowning, water is thrown on the flames to reduce the temperature of the burning material below its kindling point. In the second method of smothering, oxygen is cut off by throwing sand or some other blanketing material on the flames. But in a new method, the principle of catalysis is made use of. Catalysis is the process of greatly increasing the velocity of a chemical reaction by the mere presence of a substance, the catalyst, which itself is unchanged at the end of the reaction.

This new process was discovered by accident by two chemists who perfected it, but can give no satisfactory explanation of the phenomenon they have unleashed. These men, Charles Allen Thomas and Carroll A. Hochwalt, consulting chemists



Demonstrating with laboratory equipment the new "catalytic method" of quenching flames, an artificial fire being used for the experiment

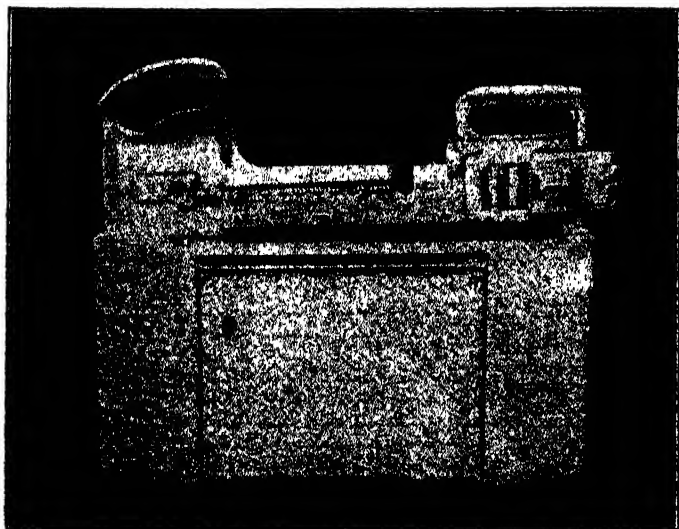
the "why" into the laps of the assembled scientists. Telling of their discovery, Mr. Thomas said:

"We started work by adding material to water to increase its effectiveness on wood fires. We accidentally found that sodium potassium carbonate would even put out a gasoline fire. This led to further work which, in turn, brought us to the remarkable discovery of the 'catalytic method' of extinguishing fire.

"Water is a representative medium for cooling material below its kindling point, and carbon tetrachloride, foam, and various other means have been used to blanket oxygen from the fire. Yet this catalytic

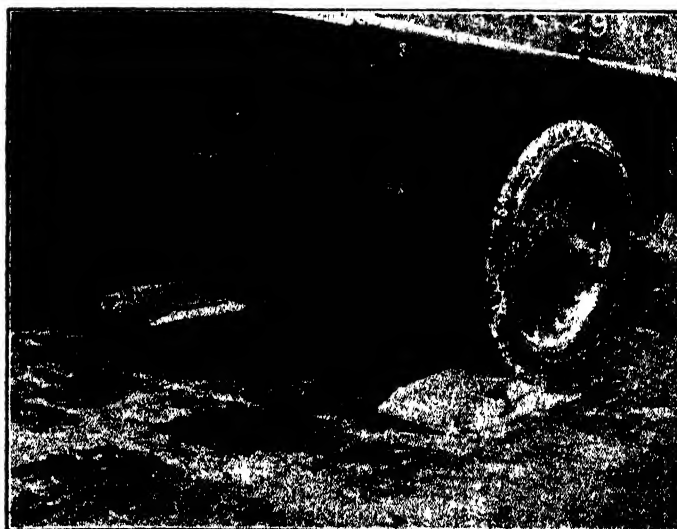
which blanketed the flame. Thus we thought that ammonium carbonate would work even better, since it decomposes much easier to carbon dioxide. We were greatly surprised when it did not work. Further work showed that this phenomenon resided with the potassium. Rubidium of caesium also exhibited this remarkable result.

"After developing an apparatus for testing, it became possible to investigate the water soluble compounds for the presence of the same catalytic flame-extinguishing property as is possessed by sodium potassium carbonate. With a few minor exceptions, every element capable of forming a



Whe World

Close-up view of a new single-wheel scale which is being used in Chicago in checking overloading of trucks to enforce a city ordinance. For either front or rear wheels



Two of these scales are placed in position, the truck is backed on them, and the weight of each wheel noted. Besides being very efficient, these scales are portable

of the Fyr-Fyter Company of Dayton, Ohio, frankly admitted their mystification when they described their process before a general session of the American Chemical Society at St. Louis, Missouri, recently. While they demonstrated the effectiveness of their method, they threw

method neither cools nor blankets a burning oil fire.

"We discovered that a solution of sodium potassium carbonate extinguished an oil fire. We thought we knew why this compound put out the fire, namely, because the compound had given off carbon dioxide

water soluble salt was studied. Practically all of the salts of the alkali metals exhibited this catalytic fire-extinguishing effect.

"A peculiarly interesting point is the fact that all of the compounds of the alkali metals that have oxygen in them have a
(Please turn to page 85)

Learning to Use Our Wings

This Department Will Keep Our Readers Informed of the Latest Facts About Airplanes and Airships

CONDUCTED BY ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York City

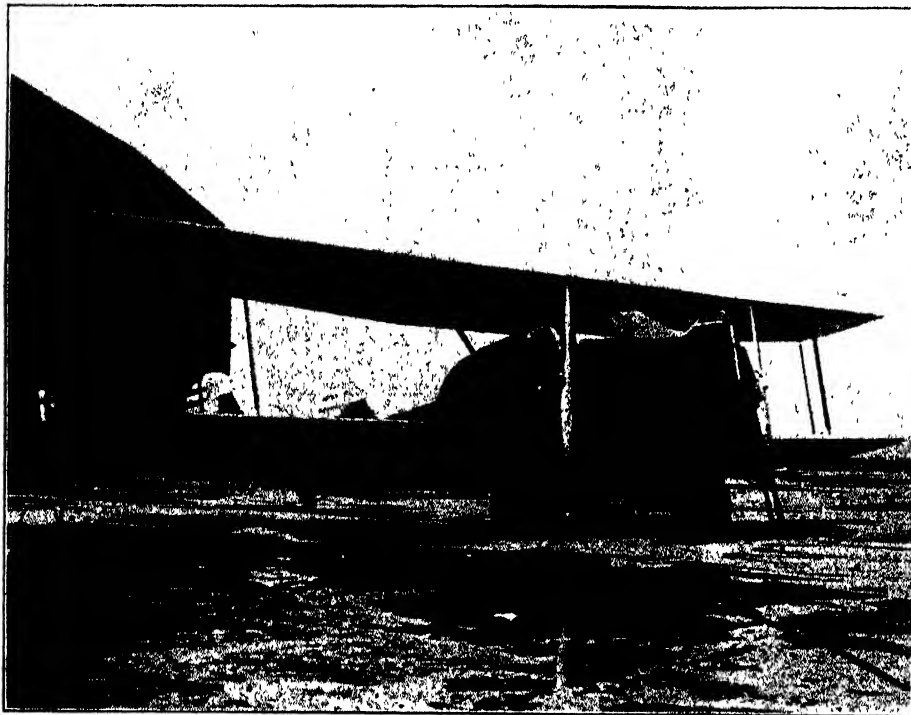
The Keystone "Pirate"

THE Keystone *Pirate*, shown in our photograph, is one of the best bombardment planes of the day. It weighs

load, from a number of small 100- or 200-pound bombs to one weighing a ton. The bombs are dropped by a release mechanism operated from the bombardier's position in the nose of the plane. In front of the bomb

addition to a single machine gun that can be fired through an opening in the floor.

By a process of evolution the American bomber has attained a flexibility and completeness as a fighting machine which is remarkable.



The Keystone *Pirate*, described in these columns and illustrated above, will carry 2150 pounds of bombs, a crew of five, and fuel for a flight of 500 miles

7115 pounds empty, carries a bomb load of 2150 pounds, and with a crew of five and sufficient fuel for 500 miles, has a gross weight of 12,230 pounds. It is equipped with two geared Liberty engines, and is sturdy and clean in design, with the engine nacelles faired nicely into the lower wing.

The Army bomber is not always the best example of refinement in aerodynamics, however. It is in the disposition of armament, crew and bombs that the main interest of the *Pirate* lies.

In the fuselage between the wings is a large bomb bay. A standard army bomb rack is installed. Any combination of bombs can be carried to make up the full

bay is the cockpit for the two pilots who sit side by side, while in the nose is the station for the forward gunner who is placed above the pilots, either one of whom can act as bombardier. Behind the bomb bay, in the fuselage, is a compartment for a radio operator and another gunner. A catwalk over the top of the fuselage provides a passage-way from front to rear cockpits permitting personal contact between all members of the crew.

The armament is such that there are practically no blind areas. Two Lewis machine guns on a flexible mount are in the nose of the fuselage at the top, while above the rear cockpit are two more in

Airship Hangars

DR. ARNSTEIN, in "Aeronautics," published by the American Society of Mechanical Engineers, discusses the important subject of airship hangars, which owing to their enormous size constitute quite a problem for the architect and structural engineer. Wind pressures are a particularly difficult proposition in the design of such structures.

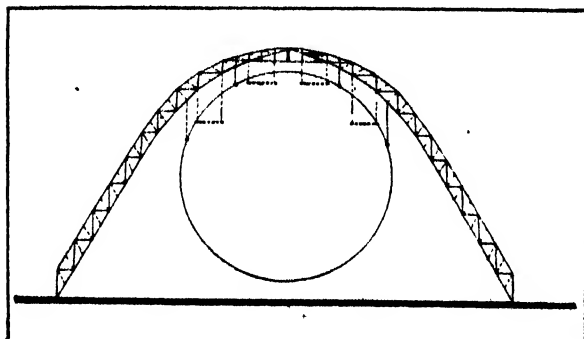
We are always accustomed to thinking of wind as producing impact pressure on the side of buildings. This view is quite erroneous. Impact pressure prevails only over a very small portion of the windward face of a building. The air sweeping over the building at a greater speed than in unobstructed areas actually produces suction over the greater part of the surface. This is shown clearly by the diagram below.

A hangar will not always fail by caving in. It may burst outwards, an idea entirely at variance with our usual conceptions. It can readily be seen that to meet the real existing wind forces, the structural engineer will have to make quite different computations than those he usually assumes to be correct.

Dr. Arnstein recommends a circular hangar, in which air disturbances and therefore forces are less than in hangars of more conventional block type.

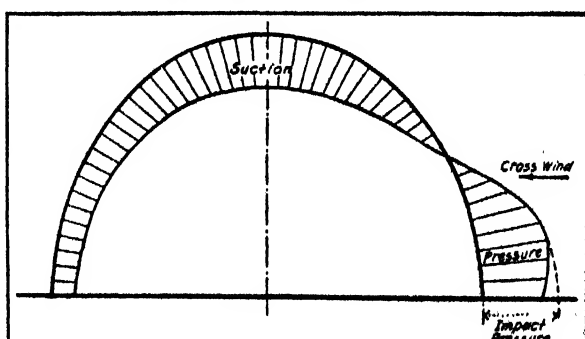
Another reason for the circular hangar is that with lesser disturbance of the air flow, the handling of the airship when taken in or out of the hangar is much easier. The semi-circular design avoids most of the eddies and vertical currents which accompany the wind flow over and around a large rugged shed with wide-spanning square doors. Further, such an arched design provides the maximum strength and consequent economy of labor and materials.

The arched cross-section lends itself also to neat suspension and erection of the airship at the center with plenty of workshop space on the floor on either side.



Left: Cross section of arched circular airship hangar, showing suspension of ship and the adjustable platforms

Right: Note the small area of wind pressure, as compared with the enormous area affected by the resulting suction



It is not impossible that even for large airplane hangars, a similar principle might be found useful.

Welding Strong Aluminum Alloys

THE strong aluminum alloys such as duralumin are remarkably well adapted to aircraft construction, owing to their strength and lightness. The main drawback to their use is the multiplicity of rivets. Riveting requires three or four operations—piercing, countersinking, inserting the rivet, and driving. The reason steel fuselages instead of dural fuselages have been used hitherto is because steel fuselages can be so readily welded together.

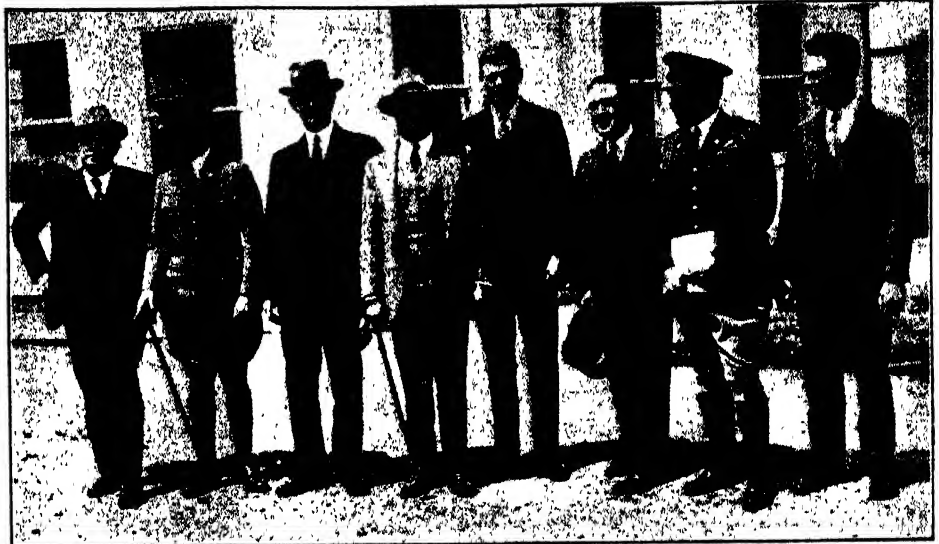
Now the Aluminum Company of America after lengthy investigation announces that the strong aluminum alloys can be successfully spot welded. Water-cooled electrodes are employed. They are tipped with chromium whose melting point is much higher than that of aluminum. The welding tips are carefully rounded.

The two strips of material are pressed together with a force of nearly 100 pounds, and a current of several thousand amperes is passed between two electrodes and the strips to be joined. With four welding spots, two strips showed a greater strength in the welds than in the strips themselves. The discovery adds a most valuable method to aircraft construction.

A Powerful Passenger Plane

ONE of the important objectives of the Daniel Guggenheim Fund for the Promotion of Aeronautics has been the fostering of passenger air transport in the United States—the only branch of air work in which we lag behind Europe. In pursuit of this policy, the Fund made an equipment loan to the Western Air Express for the purchase of large three-engined passenger planes. These were developed in record time by the Atlantic Aircraft Corporation, and the Fokker *F-10*, the most powerful passenger plane ever built in the United States is a credit to the Fund, the Western Air Express and the builders alike.

The *F-10* is a monoplane of typical Fokker construction, equipped with three Wasp engines of 400 horsepower each, and carrying a useful load of 4950 pounds which includes 12 passengers, two pilots, and 480 pounds of mail or express in addition to some 300 gallons of fuel and oil, giving a range of 600 miles. With the fully loaded



International Newsweek

Just before a test flight in the Fokker *F-10*. On the extreme left is Prof. Alexander Klemin, aviation editor of the *SCIENTIFIC AMERICAN*. Fifth from the left is Colonel Charles A. Lindbergh who piloted the ship on the flight

gross weight of 11,500 pounds the high speed is 148 miles per hour.

The plane is structurally sound and well streamlined. Lindbergh, with whom the

load and its very high speed will be powerful factors in making its operation profitable. But the most interesting points in the machine are to be found in the interior accommodations.

The passenger cabin is free from all obstructions and bracing. It is rectangular in shape, 18 feet three inches long, six feet one inch high and five feet wide. The seats of wicker construction are light, yet very comfortably upholstered. Fastened to the floor by only two legs, they permit of considerable movement at the will of the passenger. Above each row of seats there is a shelf for clothing or baggage. Neat nickel-plated fittings, ash trays, large sliding windows, which slide longitudinally, all serve to give the maximum comfort to the passenger. For use in cold weather, an exhaust heater is connected to the cabin from the center engine.

Noise is one of the difficulties of aviation. It is impossible to conceive of a design where engine and propeller will be entirely noiseless. The more promising plan for the present is to try to deaden the noise. In the *F-10* the walls, ceiling, and floor of the cabin are padded with balsa wool. As a result, even when the engines are developing their full 1200 horsepower, it is possible to converse with fair ease.

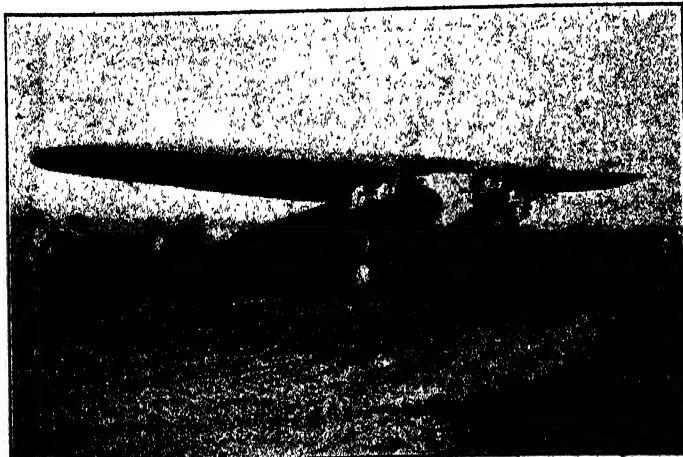
The pilot's compartment is unusually roomy and comfortable. Between the

(Please turn to page 80)

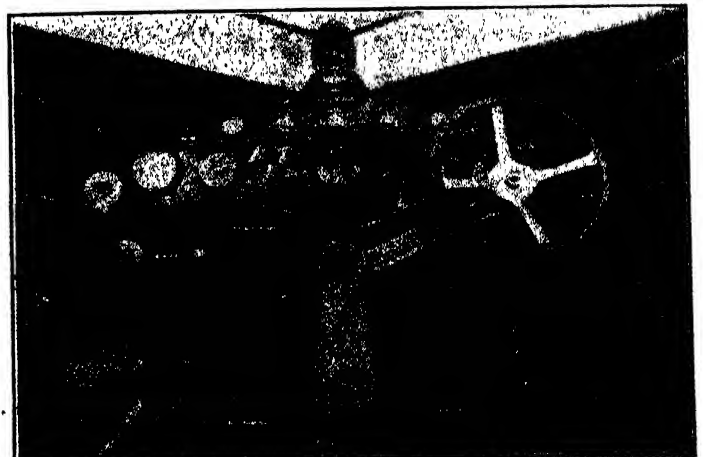


A view of the interior of the *F-10*, showing the comfortable seats

writer of these notes had the privilege of a trial trip in the *F-10*, pronounced it an excellent flying ship. The large useful



A three-quarter front view of the Fokker *F-10*, the most powerful passenger plane built in the United States



Pilots' cockpit in the *F-10*. The dual-control column is hinged in the middle so that either pilot may use it

Industries From Atoms

A Department Devoted to the Advancements Made in Industrial and Experimental Chemistry

Removing Bootblack Stains

SPOTS on light-colored hosiery put on by the bootblack are usually nigrosine, the favorite dye used in black shoe polishes.

hyde followed by ammonia may be necessary before the spot is completely removed. The spot to which the treatment is applied is finally sponged with dilute alcohol to remove any excess of benzaldehyde that

strated on gassed soldiers in 1917, it has fought an uphill battle against prejudice. Tradition established against it is still strong.

The first methods were to give oxygen to a patient through a mask over his face or through a catheter which was inserted into his nostrils. Both of these devices caused discomfort, and finally the oxygen tent was invented. This tent fits over the patient's body as shown in the illustration, being tied about his waist to make it air-tight. The tank at the right in the movable apparatus contains ice which cools the oxygen in order that the temperature in the tent may be comfortable. In the other cylinder at the left is soda-lime, which absorbs the carbon dioxide produced.

In operation, the oxygen passes over the ice and into the tent. Thence the air passes out, through the soda-lime where the carbon dioxide is absorbed, over the ice and back into the tent. The apparatus seen between these two tanks is for testing the percentage of oxygen in the tent. This apparatus can be in operation five minutes after a call has been made for it.

Instead of being of the normal 20 percent in the air we breathe, the oxygen in the chamber is raised to a percentage between 30 and 70 percent. This higher percentage of oxygen helps carry the patient through the crisis of his sickness, to support life until he shall be able to complete a natural recovery. Of 16 cases reported by Dr. A. L. Barach, of the Presbyterian Hospital in New York, 11 recovered, and, because the tent or the oxygen chamber is used only as a last resort, the cases treated were very serious.

"The inside of the chamber," Dr. Barach says in describing it, "is lined in certain places by aluminum pipes which contain circulating cold water. A large soda-lime container is placed under the bed. No other apparatus is required."

"The air in contact with the cold aluminum pipe is chilled, the moisture is condensed on the surface of the pipes and the cool dry air passes to the floor of the chamber where the carbon dioxide is removed by



The oxygen tent which has been developed to meet requirements for administering oxygen to sufferers from pneumonia. The box in the foreground contains canisters of soda-lime and ice for cooling the oxygen

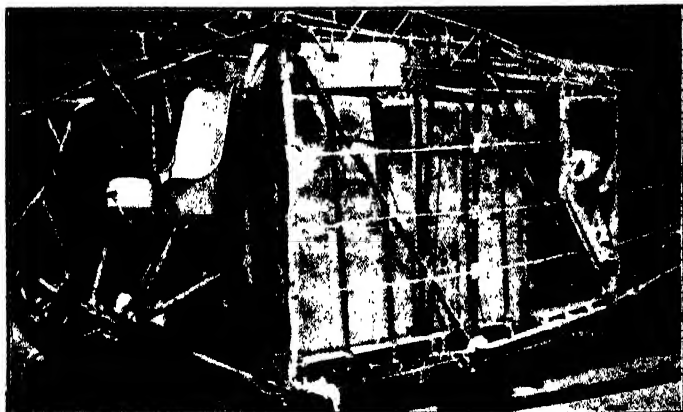
These may be removed by the application of benzaldehyde if properly used, according to M. H. Goldman, research associate of the National Association of Dyers and Cleaners. Mr. Goldman recommends the following procedure:

"Spot the stain with benzaldehyde, following this treatment with 5 percent ammonia, meanwhile gently rubbing the spot. A single treatment is sometimes all that is required, but a second and in some cases a third application of the benzalde-

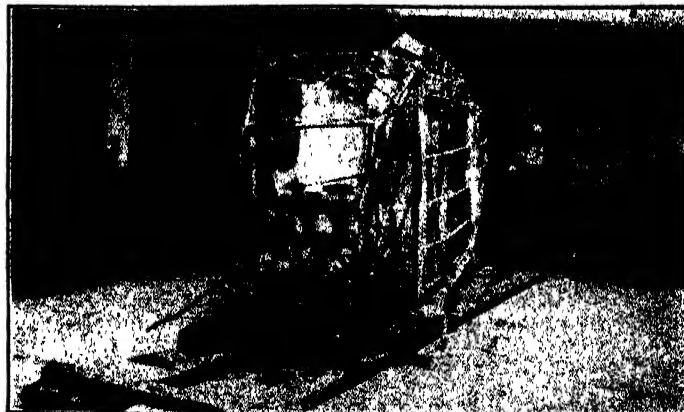
may be present, and also to avoid leaving a ring on the fabric."

Oxygen Used to Fight Pneumonia

ALTHOUGH attempts were made to employ oxygen as a therapeutic agent 200 years ago, the history of its medical success is comparatively short. Because the first attempts failed, physicians came to look askance upon it. As a result, from the time its practical service was demon-



The chemists' contribution to safety in aviation proves its merit. Although this plane crashed to the ground in a nose-dive, the newly developed alloys used in its construction, and the welded joints, were equal to the



occasion. The pilot escaped without serious injury, although he was seated between the gas tanks and the motor. Thus, by refinements in construction, is the future safety of aviation made more positive

contact with soda-lime. The air is warmed by the heat of the patient's body and passes to the roof with additional moisture and carbon dioxide. It is then chilled again and the process is repeated. By the use of these convection currents there is obtained an adequate removal of carbon dioxide, moisture, and heat."

Dr. Barach feels that there is no question about the service performed by oxygen in helping pneumonia cases. With a large part of a patient's lungs closed, the heart must work extra hard to pump blood to the unaffected parts. Enriching the oxygen content in the air speeds up the chemical reactions in the patient's lungs, thus easing the strain on the heart (which is really the dangerous phase of a pneumonia case). While he does not say that oxygen is a curative, he believes that it is obvious that it is a supportive; that is, that it prolongs the life of a patient until he shall have passed the crisis and be able to accomplish a normal recovery.

New Synthetic Solvents Make Possible Odorless Lacquer

WHEN Mother decided that the living room simply "must be done over this spring," Dad resigned himself to at least a week of turmoil around the house and a "painty" smell for another week or two which would make the room uninhabitable and give Mother a headache. Neighbors dropping in would exclaim, "My, doesn't it look nice," with the mental qualification, "but it certainly smells terrible."

This familiar experience is recalled to emphasize one of the many ways in which modern chemistry has contributed to the comfort and convenience of all of us, even though our unfamiliarity with the science is such that we would not recognize a molecule if one jumped up in our lap. Thanks to the chemists who have recently developed entirely new kinds of lacquers, it is now entirely possible for the painters to begin work in the morning, refinish the room, and leave it before Dad gets home from the



The longest lacquering oven in the world is illustrated above. This particular unit is employed for drying the lacquer on the metal that is used for making caps for jars. Strips of the metal are being fed into the furnace

office, thoroughly dry and without any unpleasant lingering odor.

Nitrocellulose lacquers, so generally adopted in the past few years as automobile finishes, include the property of quick drying among their other admirable qualities. But the development of odorless solvents for such lacquers is an even more recent improvement and constitutes a triumph for synthetic chemical research. The story of these new lacquer solvents is told by E. W. Reid and H. E. Hoffmann, of the Mellon Institute of Industrial Research in Pittsburgh, in *Industrial and Engineering Chemistry*.

"Synthetic chemistry has seen in the last few years the development of an en-

tirely new line of aliphatic chemical compounds. Among the most important of the products are ethylene glycol and its derivatives. The ethers of glycol, notably the monoethyl ether, have found wide use in the lacquer industry on account of their high solvent action. The monoethyl ether of ethylene glycol is being marketed under the name Cellosolve. Because of its high solvent action on nitrocellulose, high dilution ratio with hydrocarbons, and present low price, it has made possible the formulation of good lacquers at a low cost.

"In addition to Cellosolve itself, the other derivatives offered to the lacquer industry at this time are Cellosolve Acetate (the acetate of the monoethyl ether of ethylene glycol), and Butyl Cellosolve (the monobutyl ether of ethylene glycol). All three compounds are good solvents for nitrocellulose and resins and are in the high-boiling class—that is, they have slow rates of evaporation. This latter property is a distinct advantage, as the last portion of the solvent mixture to evaporate will be a good solvent for the non-volatile ingredients, and thus give a clear homogeneous film.

"The Cellosolve derivatives have very mild odors, and Cellosolve itself is practically odorless. This is an important consideration in the manufacture of brushing lacquers or lacquers for the commercial finishing of refrigerators, kitchen cabinets, and the like, where a disagreeable residual odor is decidedly a disadvantage. The odors of all three solvents are much more agreeable than that of ordinary denatured alcohol.

"Next to its pleasant odor, the principal feature of Cellosolve is its extraordinarily high tolerance of coal-tar hydrocarbons. This property is no doubt attributable to its dual ether-alcohol nature, and it is indeed an advantage in the preparation of industrial lacquers containing large amounts of the cheaper diluent, toluene. Butyl acetate will tolerate 2.5 times its own volume of toluene before it ceases to be a solvent for nitrocellulose, but Cellosolve will take about 5.2 times its volume of toluene.



A seeming contrast between the old and the new—the wave-torn hull in the background, and the modern gas tanks in front—this photograph serves to illustrate how an effect was obtained, with the aid of modern chemistry, for the "movies." The scenario called for an ancient weather-beaten hull. The ravages of time and weather were successfully imitated in a comparatively short length of time by employing the all-consuming flame of the oxy-acetylene torch for reducing timbers to the "aged" state shown above

Properties of Stainless Steels

WITH stainless steel finding new uses every day and appearing in hundreds of articles of everyday use, the properties of this useful metal are of general interest. While there are many kinds and grades of stainless steel, they are all characterized by their high content of chromium. F. R. Palmer, writing in *Chemical and Metallurgical Engineering*, classifies stainless steels according to their chromium content, dividing them into three groups, A with less than 14 percent; B with more than 16 percent and C, with enough chromium and nickel to make the steel non-magnetic. The properties of the three groups are tabulated below.

The A-B-C of Stainless Steels

	A	B	C
Analysis	Chromium less than about 14 percent. Carbon less than about 0.4 percent. May contain small percentages of tungsten, copper, nickel, silicon, molybdenum, et cetera. This group is magnetic.	Chromium more than about 16 percent. Carbon less than about 0.4 percent. May contain small percentages of copper, nickel, silicon, molybdenum, tungsten, et cetera. This group is magnetic.	Contain enough chromium and nickel to make steel austenitic and non-magnetic. Usually contain twice as much chromium as nickel or vice versa.
Heat Treatment	Respond to hardening, tempering, and drawing. Resulting physical properties depend on analysis.	Heat treatment not recommended. Naturally soft—usually having a Brinell hardness under 200 and seldom over 250.	Do not respond to heat treatment.
Toughness	Structurally dependable. Not brittle in sharp-notched sections or under impact.	Have low impact resistance especially in notched sections. Not dependable for bolts and similar notched parts when used under impact.	Extremely tough at all times. Thoroughly dependable for any type of shock service within the capacity of their strength.
Grain Growth	Not subject to excessive grain growth at incandescent temperatures. Thoroughly dependable at any temperature for supporting any load or shock within carrying capacity.	This group is divided with regard to grain growth. Simple chromium steels and those containing high silicon or aluminum subject to excessive and dangerous grain growth and become very brittle.	Do not become brittle due to grain growth—thoroughly dependable for high temperature service.
Hot Working Qualities	Readily forged, pierced or rolled. Air harden on cooling.	May be forged, rolled or pierced. Steels subject to grain growth must be heated very quickly. Those not subject to grain growth are heated in the usual way.	May be forged, rolled or pierced. Become work-hardened progressively below 1800 degrees, Fahrenheit. Do not air-harden.
Cold Working Qualities	Can be cold drawn into wire, cold rolled, bent, formed, upset, coiled and deep drawn.	Can be cold drawn into wire, cold rolled, bent, formed, upset, coiled and deep drawn. Not quite as easily worked as Group A with equal carbon content.	Can be cold drawn into wire, cold rolled, bent, formed, upset, coiled and deep drawn. Work-hardened twice as rapidly as Group (A).
Machining	Machine readily with properly designed tools.	Machine readily with properly designed tools.	Very difficult to machine. An outstanding objection to this group.
Riveting	Make excellent cold rivets. Not recommended for hot rivets driven above 1500 degrees, Fahrenheit, on account of air-hardening.	Due to low impact values, not desirable for either hot or cold rivets.	Excellent for either hot or cold rivets. Hot rivets may be driven at a high temperature.
Welding	Can be welded autogenously and by electric arc or resistance. Weld air-hardens. No grain growth.	Can be welded autogenously and by electric arc or resistance. Those metals subject to grain growth become very brittle adjacent to the weld.	Can be welded autogenously and by electric arc or resistance. Weld does not air-harden and is very tough. An excellent group for welded products.
Corrosion Resistance	Very satisfactory for resisting weather, water and many organic and inorganic corrosives.	Possesses corrosion resisting properties superior to group (A).	Corrosion resistance depends largely upon chromium content. This group will resist some types of action that groups (A) and (B) will not. With chromium over 16 percent the resistance is excellent.
Scale Resistance	Useful for temperatures up to about 1500 degrees, Fahrenheit.	Superior to group (A)—recommended for temperatures about 1500 degrees, Fahrenheit.	The high chromium steels are as good or better than steels of equal chromium in group (B).
Strength at Elevated Temperatures	Much better than straight carbon steel for temperatures up to 1000 degrees or 1200 degrees, Fahrenheit.	Steels not subject to grain growth are better than group (A) above 800 degrees Fahrenheit.	Better than group (B) at temperatures over 1000 degrees, Fahrenheit.

Opportunities in Chemistry

DANGER to industrial progress is seen in the shortage of qualified men for research by Dr. Charles H. Herty, past president of the American Chemical Society and adviser to the Chemical Foundation, in addressing the Institute of Chemistry of the American Chemical Society. "Industrial research which is the mainspring of progress is threatened with curtailment as demand for qualified men outstrips the ability of our universities to furnish them," said Dr. Herty, "and in this lies a real danger to industrial progress."

"Sixteen years ago the American business man knew little or nothing about industrial research, but today the need for it has been impressed upon men all over the country in all lines of business and there is a question of curtailing industrial research to fit the men available. There is a very real danger in this unless it is met by pushing forward the education of young men qualified to undertake such work. Education must broaden the understanding and deepen the grasp of young men to fit them to carry on. More must be done in the universities and graduate departments must actively encourage men of high mentality to go farther. No brakes must be placed upon research but rather every encouragement must be offered to young men to fit themselves to carry on."

"Endowed opportunity" to benefit humanity awaits properly trained young men in America's great institutions, according to Dr. E. R. Weidlein, director of the Mellon Institute of Industrial Research, following the same general theme.

"The philosophy of scientific research is that no one can succeed in laboratory experimenting without benefiting his fellow men," Dr. Weidlein continued. "If a scientist is productive in his investigations, his work must result for the good of humanity. If a research laboratory is founded, it is because there is a need for it and it will bring public benefit. Every kind of scientific establishment is administered to meet a public want."

"The character of virtue is best seen in the life of the scientist devoted to the service of research. Our many research institutions and industrial research laboratories have provided endowed opportunity for young men. They have aroused individual ambitions to the highest effort. It follows then that these research establishments must have the proper type of trained research men in the organization."

"The demands for highly trained, experienced research chemists today are greater than they were at any other period of our history. When we speak of experienced research men we mean men who are capable of accepting responsibility, who have the personality to meet industrialists on an equal basis and who are capable of producing results and introducing them to commerce without any great loss of time."

"Personality is the most important quality for a research man who expects to advance in industry. Personality is said to consist of an individual's collective attributes or qualities. It is the sum total of his traits—the mainspring of his being and activities. It comprises his consciousness, his character and his will and is apparent in his conduct and behavior."

(Please turn to Page 82)

Tests of this *grainless* wood show remarkable results in wide range of industries!

Enthusiastic letters of praise coming in every day. Many report new and unique uses. Send for large free sample and find out what Masonite Presdwood will do for you.



FOR STORE FIXTURES

Two years we waited to tell the story of Masonite Presdwood — and two days after our first announcement inquiries began pouring in from every section of the country. Requests for samples already run up into the thousands. And in the meantime, this *grainless* all-wood board has been subjected to hundreds of tests by lead-

ing manufacturers in all sorts of industries.

These tests prove conclusively that Masonite Presdwood won't crack, check, split or splinter; that it possesses remarkable workability and uniform strength; that it is very dense and tough, highly resistive to moisture, and takes any finish beautifully. Presdwood also has a very smooth attractive surface on the face side, and requires no paint for protection.

The Story of Fido

Down in Gulfport, Mississippi, Presdwood was recently used in building a speed boat called "Fido". Thanks to this *grainless* wood, the boat when completed weighed only sixty-two pounds, although it is eight feet long and has a forty-eight inch beam.

Knowing that Fido could do better than thirty-one miles an hour over a straightway course, its owner decided to enter it in the Class B Outboard Race in the Gulf Hills Regatta—and Fido won the race!

Better bread boxes

A certain Wisconsin manufacturer, whose name will be given in request, has made some very severe tests with Masonite Presdwood for bread boxes, and reports that it is far better for this purpose than any other material he has ever tried.

In making the tests a large rotating steel cylinder was used; a cylinder equipped with baffle plates, hazards and heavy spikes. The boxes to be tested are put inside of this machine, each box being hurled from one

side to another and from one baffle plate to another so that it does not catch the impact in the same place twice in succession.

A box made of the regular conventional material failed under a total of 871 drops. The box made of Masonite Presdwood did not fail until it had withstood a total of 1942 drops!



FOR PANELING

In a recent letter, Mr. Leo. A. Margola of the Chicago Art Institute writes: "I have been using Presdwood for remounting valuable canvas paintings and for backing and protecting ancient and modern works of art. Before adopting this material, many severe tests proved it to be a safe, durable material, which resists the action of moisture, heat and cold without twisting, wrinkling or warping and with minimum contraction and expansion."

Several railroads are now using Presdwood as paneling in their new Pullman Cars. It is also in wide demand for outdoor and indoor signs, store fixtures, starch trays for candy factories, clothes hampers, radio boxes, cupboards, doll furniture, packing cases.

New uses practically every week

And almost every week we hear of new uses: incubators, barbecue stands, display booths, work-bench tops, bedroom screens, plaques, music cabinets, lining for trunks and wardrobes, theatre props, concrete forms and invalid trays. In addition, Presdwood is now being tested for use by manufacturers of electric equipment, organs, airplanes, clocks, tools, bowling alleys, chemicals, farm wagons, trucks, automobiles, iceless refrigerators and church furniture!

Masonite Presdwood may be exactly the material you are looking for. Write for large, free sample. It will be sent promptly on request without placing you under any obligation.

MASONITE CORPORATION

Sales Offices: Dept. 1678, 111 W. Washington St.
Chicago, Illinois

FOR PLAYHOUSES AND TOYS



Mills: Laurel, Mississippi

Masonite

PRESDWOOD

Made by the makers of
MASONITE STRUCTURAL INSULATION

IN BUILDING BOATS





The Back Yard Astronomer

A Department Devoted to Interests of the Amateur Telescope Maker

WARM weather has come and people who have put off making their telescopes wish they had done the work during the long winter evenings; people who have completed it will have the use of their telescopes during the comfortable summer evenings. Now is the time for new aspir-

ants to begin studying up on the work, from "Amateur Telescope Making."

This month we show three more home-made telescopes. Mr. Frank Murray of Axtell, Kansas, made the telescope shown on this page. Mr. Murray says: "Although my telescope is small, it is wonderful what it will reveal in the heavens. The mountains and craters of the Moon, four of Jupiter's satellites, the rings of Saturn, and the phases of Venus are all clearly visible through it."

"After three months of work I succeeded in producing a parabolic mirror, but it was certainly not without its difficulties. The total cost of the telescope was less than 25 dollars and I wasted a great deal of material due to inexperience."



Mr. Murray and his four-inch reflector

"The mirror is four inches in diameter, one half inch thick, and has a focal length

of 30 inches. The tube is constructed of six cypress slats screwed to a hexagonal block of wood at the bottom and bolted to an iron ring at the top. I have a portable altazimuth mounting with a drawer in the base for accessories, and a fixed equatorial mounting of the German type for astronomical work."

"I ground and polished a lens of three eighths inch focal length for the eyepiece, giving a magnification of 80 diameters. I also made the diagonal. Thus the telescope is completely home-made excepting the finder, which was a pocket spy-glass."

Here is another letter from the middle-west, sent in with a photograph, by Mr.



Mr. Bergstrom's six-inch reflector

H. O. Bergstrom, a locomotive engineer at North Platte, Nebraska (P. O. Box 491). Mr. Bergstrom's first telescope was described in the issue of December, 1927, page 554. He now writes as follows, concerning a second he has finished: "I just got your letter a little while ago. I am at this moment at the round house getting ready to go out on a 'Green Fruit' (about 100 of 'em), so thought I would mail you two snapshots I have in my pocket. They are of the eight and one half inch reflector I had mentioned to you before."

"The mounting is built on the same general plan outlined in your book. The axes are made up of two one and one half inch cross tees joined together by a nipple, set at right angles to each other, and milled out to allow a one and one half inch pipe to slip through for polar and declination motion. Plugs with holes drilled through, threaded and fitted for wheel-handled set screws, hold the axis in position after the tube has been set."

"For those who have only a little spare time to use playing with telescopes, this mounting is quickly and easily made and is very satisfactory. Worm gears and setting circles can easily be attached."

We reproduce also an interesting photograph of a telescope, sent in by Mr. P. J. Naudé, 241 Market Street, Fairview, Johannesburg, South Africa. Mr. Naudé's telescope has a seven-inch mirror. He expects soon to make a 14-inch. He furnished no further details of his instrument, but the photograph speaks for itself. The SCIENTIFIC AMERICAN (Please turn to page 84)



A telescope made in South Africa

**DON'T FOOL
YOURSELF**

Better to be safe than sorry
when halitosis is involved



Halitosis may get

*Employers prefer fastidious people
... halitoxics not wanted.*

you discharged

MORE and more, employers insist on having about them people who are fastidious. Sooner or later, those with halitosis are "let out."

The true reason for discharge, however, is usually hidden under such phrases as "Inefficient," "You can do better elsewhere," "We need a more experienced person," etc.

Realize these facts about halitosis. That, due to modern habits, it is much more prevalent than is suspected. That it is a definite liability in friendships, affections and business. That you can have it and not know it.

The one means of being sure that you are free from it is to rinse the mouth systematically with Listerine. Every morning. Every night. And between times when necessary, especially before meeting others. Keep a bottle

handy in home and office for this purpose.

Listerine ends halitosis instantly. Being antiseptic, it strikes at its commonest cause—fermentation in the oral cavity. Then, being a powerful deodorant, it destroys the odors themselves.

If you have any doubt of Listerine's powerful deodorant properties, make this test: Rub a slice of onion on your hand. Then apply Listerine clear. Immediately, every trace of onion odor is gone.

With these facts before you, make up your mind to keep yourself on the safe, polite and popular side by using Listerine. Lambert Pharmacal Company, St. Louis, Mo., U.S.A.

READ THE FACTS *1/3 had halitosis*

68 hair dressers state that about every third woman, many of them from the wealthy classes, is halitoxic. Who should know better than they?



**Have you tried
the new Listerine
Shaving Cream?**

LISTERINE

The safe antiseptic

Cools your skin while you shave and keeps it cool afterward. An outstanding shaving cream in every respect.

Strays From the Ether

A Monthly Review of the Progress Made In All Branches of Radio Communication

Perfect Reception in Hawaii

IT is said that the job of radio operator at Pearl Harbor, Hawaii, is the most desired assignment among navy radio men. In this location, radio weather is very nearly perfect throughout the entire year. Static here is almost unknown and operators of the station declare that it is much easier, for example, to maintain uninterrupted communication between Honolulu and Samoa, a distance of 2280 miles, than between Washington and San Juan, only 1150 miles apart, due to the fact that there is heavy static in the Atlantic area which interferes with reception.

And probably the absence of static and the presence of ideal radio conditions are not the only reasons why operators prefer this station. The location is only 15 miles from Honolulu and surf bathing and boating afford constant recreation. When off duty there are radio broadcasts from Honolulu to entertain the tired operators.

Custom-built Sets

IN a recent bulletin issued by the Radio Manufacturers Association, the statement was made that 20 percent of the radio receivers now in operation in the United States have been constructed by custom set builders. In part, the bulletin reads as follows:

"Many of the so-called radio nuts and circuit hounds of a few years back have found in their hobby not merely a fascinating pastime, but a means of embarking in business on their own account, according to a statement recently issued by the Radio Parts Committee. Many of them, as custom set builders, are enjoying incomes of from 10,000 dollars to 15,000 dollars yearly. It is estimated that 20 percent of the receivers now in operation in the United States have been built by these specialists, who frequently operate from their own homes, from small shops or from radio, hardware, or electrical stores. They are, for the most part, highly qualified in-

dividuals who serve a discriminating clientele that requires its radios, like its furniture and interior decorations, to be distinctive and individual.



Underwood and Underwood

According to a government report, Chicago is one of the foremost cities representing radio manufacturers in the world. Photograph shows Louis A. Dumond, manager of the Industrial Department of the Chicago Association of Commerce, and H. L. Rockhill, special agent in charge of the district census

"These men do little or no advertising, yet they have developed a large clientele through the reputations which they have acquired from the praise of satisfied users of their receivers. Many of these set builders report that, contrary to what might be supposed, the custom-built receiver is not a serious competitor of the factory-made articles. To a great extent, the former is used in localities where unusual reception conditions require an exceptional receiver

—in territories, for example, where extreme congestion on the part of broadcasters requires extreme selectivity."

Tone Control

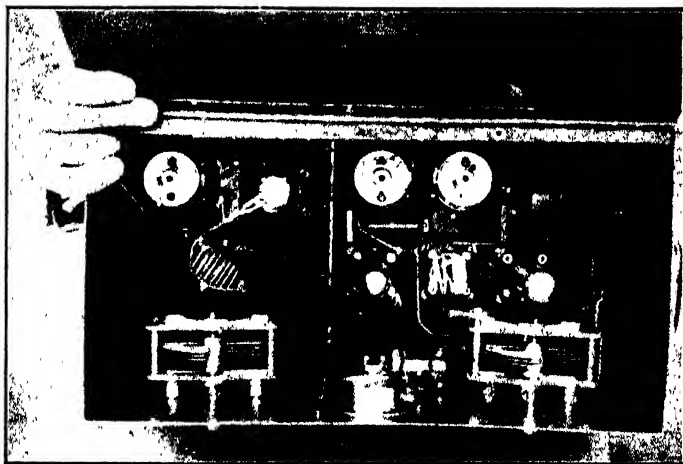
FOR the reproduction of speeches and band music, the operator of a radio receiver usually wants sharp, crisp reproduction. On the other hand, for certain vocal and instrumental pieces, soft, mellow reproduction is most desirable. These two results, however, cannot be obtained without a special control. Therefore, it is suggested that those who wish to get the most realistic reproduction possible from their radio sets employ a simple tone control consisting of a clarostat connected in series with a one quarter microfarad condenser. This combination is to be connected in parallel with the loudspeaker input. Varying the resistance of the clarostat serves to increase or decrease the crispness of the reproduction.

Is a Fixed Condenser Really Fixed?

IN the usual fixed condenser consisting of alternate layers of a dielectric and tin foil, the capacity is often far from fixed. In a poorly constructed condenser, when the condenser is being charged and discharged, the layers of tin foil move toward and away from each other. While it is true that such movements may often be only a millionth of an inch in amplitude, yet when the dielectric is very thin, such a minute movement is enough to cause considerable fluctuation in capacity.

Any motion of the elements of the condenser causes a wasteful power consumption in the condenser itself, especially at radio frequencies. This wasted power may be a large part of the total power in the circuit. To reduce this loss to a minimum, the condenser elements must be held rigidly in place.

The following process of manufacturing a fixed condenser, as developed in the



Underwood and Underwood

The first coast-to-coast two-way communication ever held on the ten-meter band was recently reported from NU-2NJ. A shield grid tube is used in the receiver



This is the ten-meter transmitter at NU-2NJ, located at Upper Montclair, New Jersey. This set has also "worked," for two hours, EF-8CT, Arachon, France

Dubilier Research Laboratories, is now universally accepted as correct. Under a pressure of several thousand pounds per square inch, a dielectric is compressed with the metallic electrodes into a solid mass. Only a homogeneous material such as mica can thus be treated. By this compression, the mica and metal foil are brought into such intimate contact that the tin foil is made to adhere to the mica so that it can be removed only by scraping.

When a condenser is made in this manner, it is obviously impossible for the elements to move and, therefore, there is little chance of power loss.

Patent Situation Clears in Radio

"THE patent situation as regards receiving sets has been definitely stabilized," says Louis G. Pacent, President of the Pacent Radio Corporation. "The manufacturers know where they stand. Consequently they can go ahead producing better radio sets for 1928 with the full knowledge that the product has complete patent coverage and protection."

2XAL to Broadcast Television

IF present plans mature, this fall will find television programs being broadcast over 2XAL, the short-wave radio station of WRNY. The work will be conducted by the Nakken Television Corporation, a subsidiary of the Pilot Electric Manufacturing Company.

According to present plans, production of television receivers will be started at an early date. These will be so constructed that they can be plugged into present radio sets, and if the demand warrants, it is possible that a complete combination broadcast and television receiver will be placed on the market.

Overloading Power Tubes

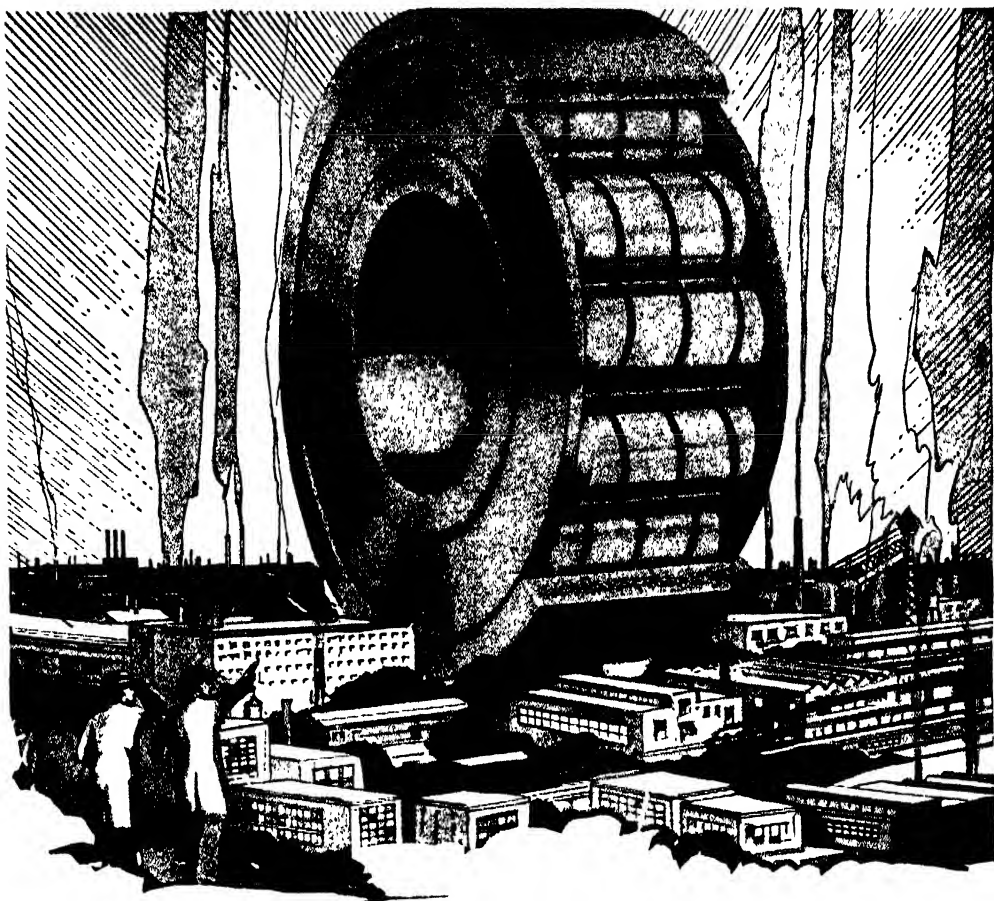
MANY of the present day "B"-battery eliminators supply voltages which are in excess of the maximum to be supplied to power tubes. A 171 type with a 40-volt grid bias should never be supplied with a plate potential of more than 180 volts. If the eliminator supplies a higher voltage than this, distortion will result. If, using the grid bias recommended by the tube manufacturer, distortion is present, a variable resistance such as a standard clarostat should be connected in the "B"-plus maximum lead. By means of this variable resistance, the voltage as supplied to the plate of the tube may be changed until clear reception with a minimum of distortion is obtained. This method of distortion control can be applied to any eliminator.

Radio Safeguards Ferry Boats

A METHOD of avoiding shallows by the use of a radio depth-finding system has recently been installed on ferries plying the Baltic Sea between Germany and Denmark, according to information obtained from the Department of Commerce.

Parrots as Announcers

IF a recent press report that the British Broadcasting Company is teaching parrots to do some announcing is true, many of the radio announcers throughout the world may have to start looking for other positions.



Hyatt Has Earned Industry's Admiration!

IN their epoch-making performance, sturdy Hyatts have supplied the final endorsement of anti-friction bearings.

Throughout all industry . . . in automotive, railroad, industrial and farm equipment . . . their magical endurance and economy has won them overwhelming preference.

With Hyatts, power waste, friction, wear and lubrication needs are minimized. Smoother running machinery . . . longer life . . . lower production costs are assured.

These are good and sufficient reasons for Hyatt supremacy. But often more important to industrial progress is Hyatt's aptness for solving the most difficult of engineering problems.

Hyatt counsel is available at your call.

HYATT ROLLER BEARING COMPANY

Newark Detroit Chicago Pittsburgh Oakland

HYATT
ROLLER BEARINGS

PRODUCT OF GENERAL MOTORS

The British Broadcasting Company has planned, but as yet the results have not been announced, to stage a parrot program. A dozen birds placed before the microphone will be urged to talk and the first one to utter an intelligible remark will be declared the winner. Just how this intelligible remark will compare with the thousands of remarks made daily by radio announcers we have no means of telling. But we are sure that we would prefer a parrot to some announcers whom we have heard.

Shield Grid Booster Stage

THE introduction of the shield grid 322 tube has opened a new field in radio-frequency amplification, for not only does this tube have an amplification of something like 10 times the ordinary 201-A type, but it also has a very small capacity between control grid and plate so that in some cases neutralization of the radio-frequency amplifier is not necessary.

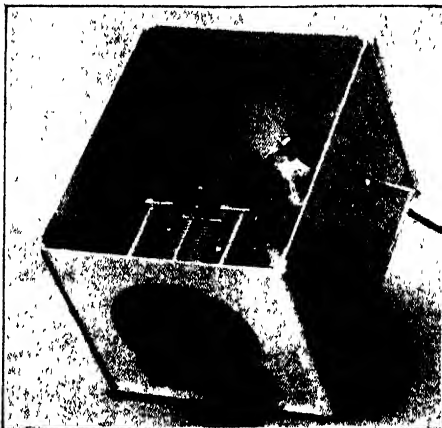
Of course, every experimenter and set-builder desires to use the 322 tube as a radio-frequency amplifier, because of the tremendous amplification obtainable. However, there are thousands of sets giving good service which are not shielded, and cannot readily be shielded. Consequently, the 322 tube cannot be used, as the circuit and the tube must be carefully shielded to get the utmost from it.

For some time the writer has been experimenting with a one-stage radio-frequency amplifier which could be added to the large number of Browning-Drake sets which are in use. This amplifier employs the shield grid tube. In fact, the design shown in this article exceeded all hopes, for not only does it give a tremendous radio-frequency amplification, but it increases selectivity to a marked degree. It has also been found that the one-stage amplifier can be used, not only on Browning-Drake sets, but on any existing receiver, simply by making a connection to the stator plates of the first tuning condenser. By using this one-stage device, the writer has received signals that were entirely inaudible before.

The construction of the one-stage 322 booster is quite simple indeed as the Browning-Drake Corporation furnishes a kit consisting of the coil, condenser and dial, together with a set of shields, a radio-fre-

quency choke, the four-wire cable, 10-ohm resistances and the mounting hardware, so that all that is necessary for the constructor to purchase is a tube socket, and the following condensers: a one half microfarad, a .0001 microfarad, and a .00025 microfarad.

The picture wiring diagram and the schematic wiring diagram are both given so that little constructional data is neces-



The assembled shield grid booster stage described in these columns

sary. It should be noted, however, that the stator plates of the tuning condenser go to the top of the 322 tube. The two 10-ohm resistances, put in as indicated, cut down the six volts from the storage battery to 3.3 volts which is the correct voltage for the 322. It is noted that the one-stage booster is run from a storage battery as it is not feasible to light the filament of the 322 from raw alternating current.

In using the one-stage booster on any Browning-Drake assembly, all that is necessary to do is to disconnect the antenna from the set, connect it to the antenna post of the booster, which is shown on the case, and to connect the wire lead, which is on the right of the booster, to the antenna post on the Browning-Drake receiver. The ground is left in its position on the set proper.

From the wiring diagrams, it may be noted that a filament switch is inserted in the positive "A" battery lead to control the filament of the CX-322 tube. This makes the separate amplifier unit independent of the receiving set proper and permits it to be

used on any radio set. When using the booster on Browning-Drake receivers, particular care should be taken that the set is well neutralized before adding the booster. Volume may be controlled as before on the receiving set.

When using this one-stage booster with other receivers, the wire on the right, which comes from the booster, is connected to the stator plates on the first tuning condenser. The other connections are the same as before. The operation of the booster is very simple indeed as all that is necessary to do is to tune in the receiver by means of the regular control and then tune the booster.

Tuning on the booster is not extremely critical although it increases the selectivity of the set in a marked degree. It also increases, at the same time, the signal strength as much as 50 times. The antenna used on the receiver when this booster is employed should be very short, in fact, not more than 25 to 40 feet, with as much of this vertical as possible.

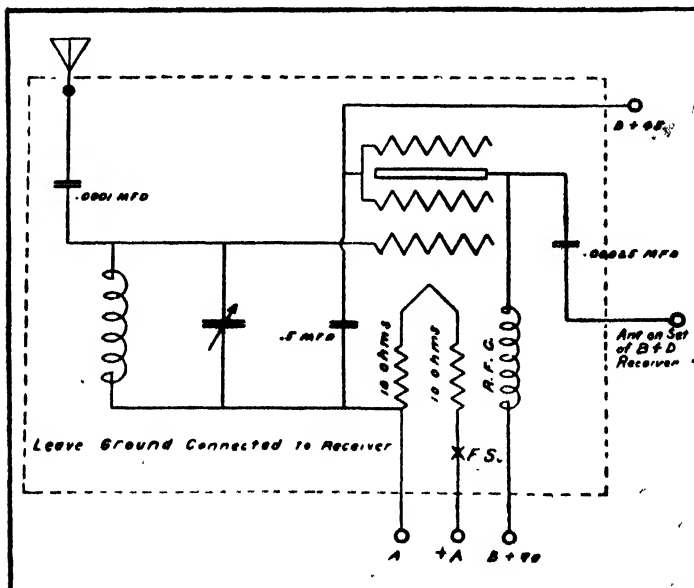
It is sincerely hoped that many, using Browning-Drake receivers, who have wanted to add another stage to their present set, will build the booster, for it gives all the advantages of a set using the 322.

Also others who wish to employ the 322 with all its advantage as a radio-frequency amplifier will want to construct this device, especially as the 322 tube cannot be used advantageously in an unshielded receiver.—Written especially for the SCIENTIFIC AMERICAN by Glenn H. Browning.

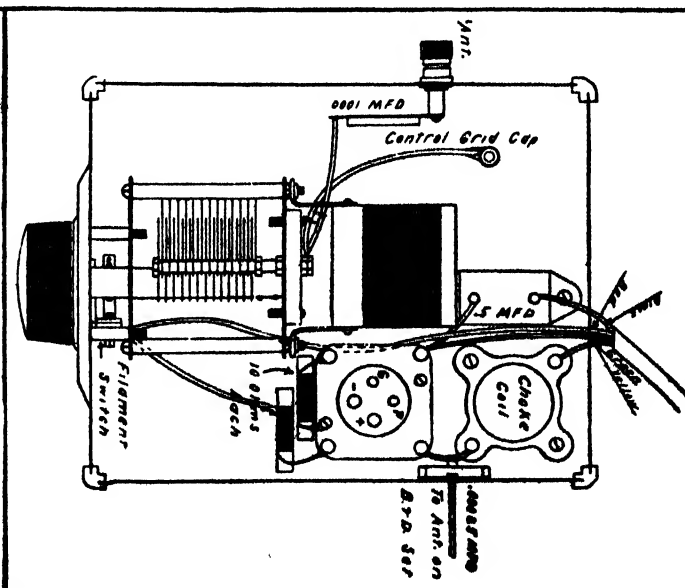
The Future of Television

UNDAUNTED by the various statements made by men high in the radio industry regarding the remote possibility of practical home television receivers, John L. Baird, Scotch television inventor, recently made the confident prediction that before long, owners of radio receivers will be able to sit in their homes and go on a world-wide radio tour, by means of a combination of radio 'phone and television transmission.

It is interesting to note that Mr. Baird has abandoned the use of a moving beam of light scanning the object to be transmitted, and is now using ordinary flood lighting. One significant feature of this is that when the apparatus has been developed to a point



The schematic circuit of the shield grid booster stage. Such a unit may be connected to any existing receiver



This picture diagram shows the same connections as in the schematic at the left, but shows the actual wires

where flood-lighted subjects can be transmitted satisfactorily, ordinary outdoor scenes can be sent without any radical change in apparatus.

Railroads Want Wave Bands

THE Radio Committee of the American Railway Association has recently requested that the Radio Commission reserve a wavelength band for train communication. This method of linking the engine and the caboose of a freight train has been described before in these pages. A section approximately 140 kilocycles wide is desired in the 2250- to 2750-kilocycle band.

Since the range of telephone equipment used on board trains is limited, the interference set up by such transmitters will be very slight and there is probably no reason why such a wavelength band should not be assigned.

"B" Batteries For Short-Wave Reception

THE deficiencies of socket-power devices are highly magnified when used with short-wave receivers and they are, therefore, to be considered impractical for this work. "B" batteries, either of the dry or storage type, are the only really suitable source of plate current for receivers operating below 200 meters.

Grid Leaks

THERE is no reason for the seemingly prevalent assumption that the grid leak in a radio receiver must have a value of exactly two megohms. It will often be found that a lower or higher value will give much better results. Therefore, it is to be strongly recommended that a variable grid leak of standard manufacture be employed. With such a control, this can be adjusted to its greatest sensitivity for distance reception and to a point of greatest stability when only local reception is desired. A high value will usually be found best for distance reception.

Radio in the Hospitals

A RECENT survey of the 56 institutions comprising the organization of the United Hospital Fund in New York City shows that 26 of these hospitals already have radio equipment for the entertainment of patients and that others are desirous of obtaining such installations.

Airplane Radio

IF recent tests undertaken by the American Telephone and Telegraph Company between the ground and a Fairchild cabin monoplane develop as rapidly as do most successful radio experiments, it may soon be possible for anyone within reach of a telephone to communicate with anyone who may be traveling by airplane.

"It may be a matter of five years," one engineer stated, "and it may be a matter of a shorter period before we attain our object of an actual connection service between an object moving through the air and the ground."

In the present experiments, apparatus is being used by means of which the wavelength may be changed instantly so that the most efficient and least congested channel may be found.



Handling Heavy Loads

The present quick, efficient methods of handling heavy loads owe much to wire rope; for in nothing else is sufficient strength so nicely combined with flexibility and small diameter.

Manila rope, equal in strength to 1-inch Yellow Strand Wire Rope, would be $3\frac{1}{2}$ inches in diameter.

The Broderick & Bascom Rope Co., manufacturers of Yellow Strand, were pioneers in the industry. All the wire for their famous brand is drawn to their own specifications, from Sheffield Steel.

A strand of yellow distinguishes Yellow Strand in appearance; economy distinguishes it in service.

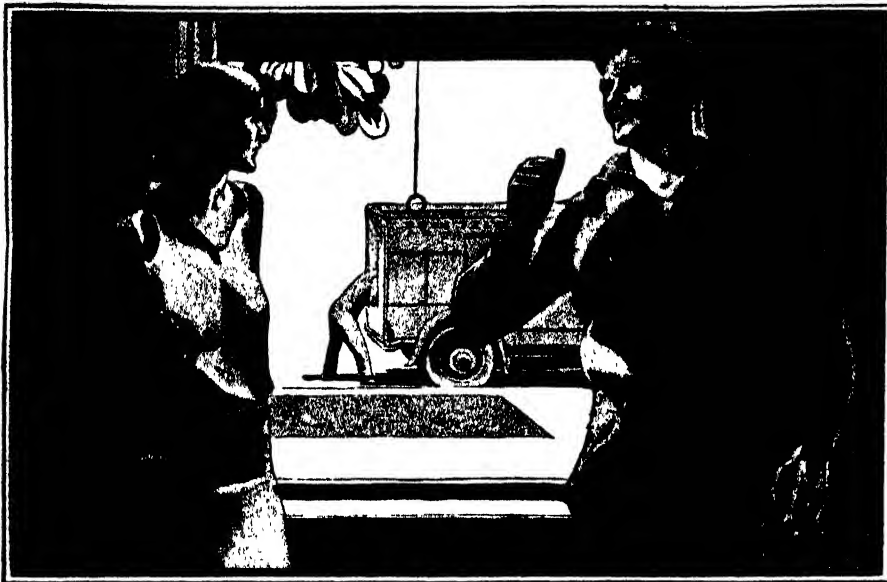
This company also makes all standard grades of wire rope for all purposes.

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Telephone service, a public trust

*An Advertisement of the
American Telephone and Telegraph Company*

THE widespread ownership of the Bell Telephone System places an obligation on its management to guard the savings of its hundreds of thousands of stockholders.

Its responsibility for so large a part of the country's telephone service imposes an obligation that the service shall always be adequate, dependable and satisfactory to the user.

The only sound policy that will meet these obligations is to continue to furnish the best possible service at the lowest cost consistent with financial safety.

There is then in the Bell



System no incentive to earn speculative or large profits. Earnings must be sufficient to assure the best possible service and the financial integrity of the business. Anything in excess of these requirements goes toward extending the service or keeping down the rates.

This is fundamental in the policy of the company.

The Bell System's ideal is the same as that of the public it serves—the most telephone service and the best, at the least cost to the user. It accepts its responsibility for a nation-wide telephone service as a public trust.

Learning to Use Our Wings

(Continued from page 69)

pilots' seats is a single control-column hinged in the middle so that the upper end may be swung in front of either seat. The wheel control can thus be used by either pilot at will, yet the drawback of a wheel in front of both pilots is avoided. Therefore, the pilot who is not at the wheel has complete freedom of motion. This single-dual system of control is becoming increasingly popular because of its simplicity and practicability.

Shortening Take-off

PLANES used for long non-stop flights, particularly when some pay load is to be carried, must be heavily loaded per square foot of wing area. This entails a long and difficult take-off run. Readers will remember the disastrous attempt of Captain Fonck to take off on a transatlantic flight from Roosevelt Field, Long Island, with a plane loaded some 25 pounds per square foot. Is there perhaps some way of helping the heavily loaded plane at the start? A. Pröll, writing in the *Zeitschrift für Flugtechnik*, has made some ingenious suggestions.

One of them is to use a hydraulic transmission gear and before starting a flight bring a flywheel up to a speed of 10,000 revolutions per minute. The energy of the flywheel is then utilized to help the engine in turning a variable-pitch propeller at a greater pitch than would otherwise be possible. Pröll estimates that transmission gear and flywheel would increase the weight of the airplane only 2 percent, and would decrease the take-off run considerably.

Another plan is to carry a tank of water, in which high pressure is secured by the combustion of gasoline. Subsequent ejection of the water backwards would then serve to increase the initial thrust. Here we can see serious complications and increase in weight.

Still another suggestion is to accumulate vacuum (if such a phrase can be employed) in a large chamber carried on board the plane, and utilize this vacuum to apply suction to the surface of the wing, in order to diminish drag and increase lift at the take-off.

These are internal devices. External devices comprise air-driven towing cars; towing cables; the use of an inclined plane; and finally, the towing of one airplane by another, as has already been done successfully for gliders.

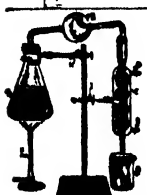
For normal commercial flying, we can see no urgent need for any of these devices. But it is quite possible that intensive use of the airplane will bring such methods into serious consideration a little later.

Ice On the Wings

THE formation of ice on the plane still remains a serious menace to winter flying—in some respects, the most serious menace. Unfortunately the subject is very obscure and does not lend itself readily to laboratory experimentation.

Pilots report ice formation quite frequently in the winter months, and if the formation is at all severe, there is nothing to do but come down.

Clarence Chamberlin and Roger Williams, for example, in one of their attempts



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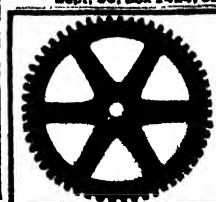
Explains the principles of flying; gives plans and instructions for building Gliders and Racers; full information on easiest way to build and fly Models of Famous Planes; also contains most complete catalog of parts, materials, supplies for Model builders. 64 pages; mailed anywhere for 5c.

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to break the endurance record in a Bellanca plane, met rain, then a drop in temperature to 25 degrees, Fahrenheit, followed by rapid ice formation. The accumulation started at the leading edge, outer edge, and trailing edge of the wing and spread from them until it covered the greater part of the wing. They also noted ice on the cowlings, the landing gear, and the leading edge of the tail surfaces. They estimated the thickness of the ice to be three quarters of an inch in some places. Only by dumping over 2000 pounds of gasoline were they able to make a safe landing. They also made the extraordinary discovery that the propeller itself was coated with ice!

Andrus, a noted meteorologist writing in *Aviation*, states that ice formation is to be feared whenever water particles impinge upon the plane's surface in flight through air at temperatures below the freezing point, 32 degrees, Fahrenheit, or 0 degrees, Centigrade. These particles may be big enough to be rain drops falling through sub-freezing air, or they may be tiny particles of fog or cloud at temperatures as low as 21 degrees below zero, Fahrenheit. While they may be existing as water droplets in the free air, upon impinging against the plane they change immediately to ice. When an airplane flies through air containing such particles, its surfaces, in smashing the surface tension of these drops, provide the trigger action to set off immediate crystallization.

It is fairly well agreed that it is not the weight of the ice which brings about disastrous results. It is the spoiling of the upper surface of the wing which, above all, decreases the lifting capacity and increases the resistance. At the same time, the streamline wires cease to be streamline and their resistance increases greatly. Other parts of the plane also have their resistance increased to varying degrees. At the same time, the ice on the propeller diminishes the airscrew's efficiency and may cause unbalance and engine vibration.

The remedies suggested are numerous. The German fliers reported that they found a covering of paraffin helpful when flying through fog and sleet towards the shores of Labrador. Chamberlin on the other hand found that oil which had smeared part of the fuselage did not prevent ice at that point.

The meteorologists suggest that better weather service will enable fliers to dodge those regions where ice forming conditions are reported.

Practical flyers seek to maneuver themselves either right above the clouds, or else to fly very low where the temperature may be higher than at altitude where freezing conditions are encountered.

A dubious suggestion is to have some vibration device shake off the ice as soon as it forms.

The elimination of struts and wires by the use of internally braced wings and landing gears is a helpful idea.

It has frequently been suggested that metal planes could be heated either by chemical or electrical means. The fear is that such a method would require a stupendous amount of energy.

The most popular suggestion advanced thus far is to extend the exhaust stacks of the engine through the leading edges of the wing.

There certainly seems to be a wide opportunity for invention and research on this problem.

Names—and what they mean



Duncan Phyfe Furniture

Back in Colonial times, at the old shop on Partition Street (now Fulton Street), New York City, Duncan Phyfe worked and produced those exquisite pieces of furniture that have only recently become fully appreciated. According to one authority, there are only a few dozen pieces of genuine Duncan Phyfe furniture to be found in all the museums or private collections today. Yet it is said that he developed a style of his own, an American Style, and Sir Purdon Clark asserted that as a worker and designer Phyfe surpassed any of his British contemporaries among whom were the great Chippendale and Hepplewhite. From the first Duncan Phyfe clung to artistic ideals and had a hard fight for business, but about 1800 the Astors took up his furniture and started the Duncan Phyfe vogue. Today the name Duncan Phyfe stands for exquisite design and superb craftsmanship. This reputation is established and secured by the few rare pieces of his handwork remaining. It is worthy of note that some names begin by being merely tags to identify a product and are soon forgotten. Other names, like Duncan Phyfe, acquire, through years of superlative merit in the product itself, a personality, a definite measure of value that is quickly recognized. Such a name, for instance, is

Tycos

It is accepted as a standard of excellence and value in the invention, manufacture and employment of instruments for indicating, recording and controlling temperature in the home, the office, the factory, the hospital, and on the farm. In industry alone the name Tycos symbolizes a Sixth Sense which makes possible the correct and efficient application of the five familiar senses—sight, hearing, smell, taste and touch. Tycos on Temperature Instruments means the same as Duncan Phyfe as applied to furniture.

The name *Tycos* was chosen to stand for a great line of temperature instruments. Many years ago, with the ideal of producing instruments of the greatest possible accuracy and reliability in indicating, recording and controlling temperature, the makers sought a name that would always stand for these instruments. *Tycos* is the name. There are *Tycos* instruments for every need. Besides the great industrial line, there are candy, bath and oven thermometers for the home, fever thermometers and sphygmomanometers for physicians. All instruments bearing the name *Tycos* have been built according to the ideal of making instruments that are the utmost in accuracy and dependability.

Tycos Temperature Instruments

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To help you maintain a temperature in your house conducive to good health.

Quality Compasses

To show you the right way in unfamiliar country.

Fever Thermometers

A necessity in every home.

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Forecast the weather twenty-four hours ahead with dependable accuracy.

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Industries From Atoms

(Continued from Page 72)

"Insatiable curiosity, the essential of scientific research, has given way under modern education methods to cock-sureness," said Dr. Gerald L. Wendt, of Pennsylvania State College on the same subject.

"The enormous amount of knowledge, accumulated by science and taught to students, is giving many the impression that everything has been discovered. Thus they develop a pride in what they do know and lose that insatiable curiosity essential to further scientific progress. The instruction now given in all our schools from kindergarten up is designed to drill into the minds of the students what we now know and to give it to them in the shortest and most condensed form.

"Too often the good student is one with a mind like a catalog or an encyclopedia. He does well in school but he does not realize that, when he enters his profession, what he will have to deal with is not so much things that are known, as entirely unknown factors. The colleges are therefore turning out too many men who have a store of knowledge but little ability to think and not enough imagination to attack the great problems not only in science but in political and everyday life."

The Microscope in Chemical Analysis

DESTRUCTION of an invaluable Della Robbia terra cotta in a Cleveland art museum was recently prevented by prompt application of microchemical analysis, according to Dr. H. S. Booth of Western Reserve University addressing the Institute of Chemistry of the American Chemical Society.

"Without microchemical methods of analysis the cause of the scaling of the surface of this very valuable art piece could not have been found without seriously marring it," Dr. Booth said. "However, with the aid of the microscope and a very small chip that had fallen off the surface, it was possible to find the cause in a few minutes and still keep the little piece intact to be replaced after the cause of scaling had been removed.

"By looking at the fragment of glaze through the microscope, minute crystals were found which had been formed under the surface by the evaporation of moisture from inside the piece. The trouble was caused by a very humid season, in which moisture had been freely absorbed into the body of the porous terra cotta, followed by the evaporation of this absorbed water bringing impurities in the clay to the surface during a very dry season.

"The fault was corrected by forcing the absorbed moisture to evaporate from the back of the piece, where it could cause no damage, by blowing air upon it with a fan and by protecting the glazed surface with a transparent water-proof coating."

Characterizing newly developed methods of using the microscope as "time, labor and money savers," Dr. E. M. Chamot of Cornell University pointed out to the Institute that invaluable information has been revealed by their use about such diverse and important materials as silk hosiery, road surfaces, talcum powder, rubber fillers, polishing powders, minerals and many other substances.

"Counterfeits of antiques and antiquities of all sorts can be detected by mi-

crochemical analyses. These methods enable the expert to make analyses without any injury to the material. They can be applied particularly to ancient ceramics, pottery and porcelain, to paintings by the old masters, to coins, to bronzes and numerous others. It is also possible by these methods to determine the authenticity and the approximate age of documents, illuminated manuscripts and paint-



R. E. Rhodes, left, inventor of the device for supplying oxygen to the interior of a vault in an emergency, is giving instructions for manipulation of the apparatus. See below

ings without injuring them in any way. Within the last few years these methods have come to the fore, particularly in our museums, and many fraudulent, worthless articles have been discovered which had been carefully treasured as genuine pieces of great value.

"A coin, for instance, can be subjected to a complete chemical analysis under the microscope without injuring it in any way. The minute sample required for this use is obtained by rubbing the coin over a piece of ground glass which removes an amount too small to be noticed on the coin but enough for such analysis."



The emergency arrives. The soda-lime has been spread around so as to absorb the carbon dioxide in the air, and the girl at the right is turning on the oxygen supply

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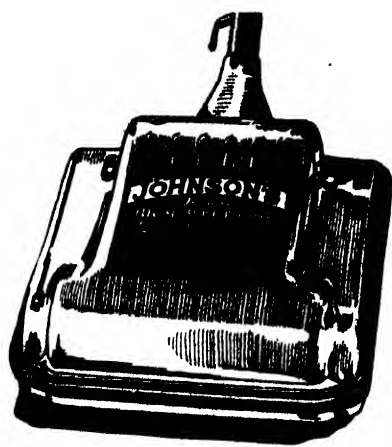
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The Back Yard Astronomer

(Continued from page 74)

SCIENTIFIC AMERICAN goes all over the world and "A. T. M." has been sent to practically every foreign country.

Just about two weeks after you receive this issue the regular annual get-together of telescope enthusiasts will be held at "Stellafane," Springfield, Vermont. This meeting is just the reverse of exclusive—everybody comes, brings his work if he can and spends a couple of days and a night communing with other souls who have

made, are making or hope to make, a telescope. This will be the third of these conventions and the previous two have been a howling success—at least nobody got any sleep. Enthusiasts motor to Springfield (there is, however, a railroad) from several states and last year real telescope fanatics journeyed 1000 miles in order to be present. Whatever sleep you may miss, you will certainly get enough to eat, for the Springfield telescope makers have a member who is a real cook. Come! Write for information—A. G. I., Tel. Ed.

The Heavens in July

BY PROF. HENRY NORRIS RUSSELL, Ph.D.



At 11 o'clock: July 7.
At 10½ o'clock: July 14.
At 10 o'clock: July 22.

At 9½ o'clock: July 30.

At 9 o'clock: Aug. 7.
At 8½ o'clock: Aug. 14.
At 8 o'clock: Aug. 22.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on July 7, etc.

NIGHT SKY: JULY AND AUGUST

MERCURY is a morning star this month and is best visible about the 21st, when he is farthest from the Sun (20 degrees) and rises an hour and a half before sunrise.

Venus passes through conjunction with the Sun on the 1st, and therefore is an evening star apparently very near the Sun, although really about 70,000,000 miles behind it. By the end of the month she may be seen low in the twilight, but not easily.

Mars is in Aries and still counts as a morning star, although he rises between midnight and 1 A.M. He is brighter than the first magnitude and already a conspicuous object.

Jupiter is in the same part of the sky and the two planets are in conjunction on the morning of July 4th when they are separated by only 18 minutes of arc—little more than half the Moon's apparent diameter. This will be a pretty conjunction, worth

getting up to see. Mars will be south of Jupiter and only about a tenth as bright.

Saturn is well placed for observation, in Scorpio, and comes to the meridian about 9 P.M. in the middle of the month. His rings appear opened out at their widest angle and he is one of the most interesting of telescopic objects.

Uranus is in Pisces and comes to the meridian about 5 A.M.

Neptune is in Leo, observable, if at all, only after sunset.

The Moon is full at 10:48 P.M. on the 2nd, in her last quarter at 7:16 A.M. on the 10th, new at 11:35 P.M. on the 16th, and in her first quarter at 9:35 A.M. on the 24th. She is nearest the Earth on the 14th and farthest away on the 26th. During the month she passes Uranus on the 9th, Jupiter and Mars on the 11th, Mercury on the 15th, Venus on the 17th, Neptune on the 19th and Saturn on the 26th.

The Scientific American Digest

(Continued from page 67)

greater extinguishing effect than those without oxygen."

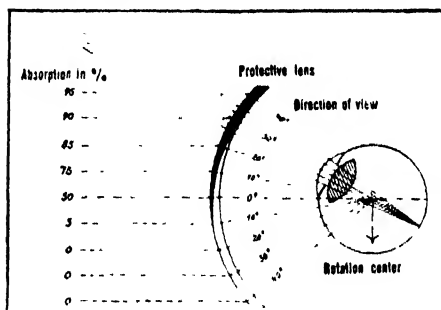
Mr. Thomas stated that the results of this discovery are now being utilized commercially in one and three quarter gallon fire extinguisher that has been passed by the Underwriters Laboratory of Chicago.

This compound puts out an artificial fire built by Underwriters Laboratory in from nine to 12 seconds, while with standard soda-acid extinguisher the shortest time is from 35 to 45 seconds.

Shaded Motor Goggles

CARL ZEISS, INC., of Jena, Germany, whose reputation as a maker of optical lenses and scientific precision instruments using lenses is world-wide, recently announced from its New York City office, new motor goggles in which is incorporated a distinctly new feature. The glasses are shaded gradually from the top down, but are clear in the bottom portion so as to shade the eyes and yet give a wide, clear field of vision.

In the upper portion of each glass a wedge-shaped lining of colored glass is



Sectional view of the new motor goggles showing position relative to eye, and the light absorption

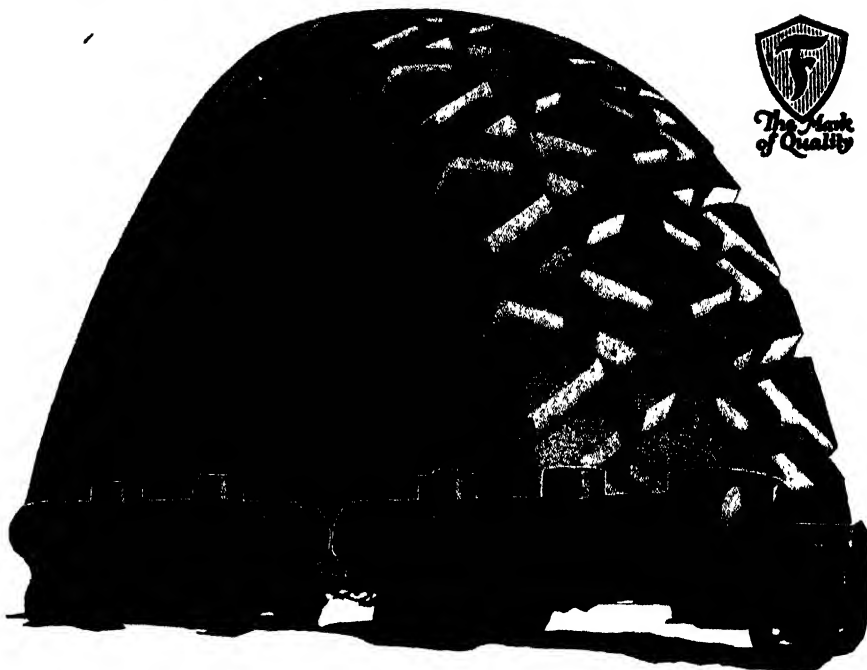
fused in, thus giving the glasses a grey-brown tint at about the center which deepens toward the upper edge. At the latter point, about 95 percent of the light is absorbed and only about 5 percent reaches the eye.

The color wedges are of the well-tried umbral tint. This does not falsify the natural coloring of objects. Thus the motorist may wear these goggles by day or night—in the first case protecting his eyes from glaring sun, and in the latter, from the beams of approaching cars. By slightly inclining his head, the user can shield his eyes as much as he wishes, or as much as is necessary under varying conditions.

Government Furnishes Free Fish—You Raise Them

OFFICIAL encouragement for small private fish nurseries is offered by the government, in order to give a better start in life to the millions of young fish needed to meet the needs of millions of American anglers. The scheme for co-operative nurseries was outlined recently before the National Game Conference by G. C. Leach, chief of the division of fish culture of the United States Bureau of Fisheries.

Co-operation by private owners of suitable bodies of water is being sought, Mr. Leach stated, because young fish reared to a length of four or five inches before they



In Step With Progress

Firestone has signally contributed to the advancement of Highway Transportation by developing the special Gum-Dipping process. The 2800 gallon tanker with 3200 gallon trailer shown above are outstanding examples of what the right tires and competent engineering can do in providing up-to-date motor transport units for today's commercial needs. Firestone Gum-Dipped Heavy Duty Pneumatics have special advantages which have brought them in to wide usage for normal, high speed and heavy weight haulage of every kind. With these Gum-Dipped Heavy Duty Tires, and complete service facilities, Firestone Dealers are in the best position to help truck and bus operators in solving their tire problems. Call your local dealer and ask about Gum-Dipped Tires and the Firestone Proposal of Service:

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Gum-Dipped TIRES

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are turned loose to shift for themselves, stand a much better chance of growing up into lusty trout and bass that will give an angler a run for his money than they would if launched as tiny "fry." Since government-owned hatcheries are of limited capacity, the necessary feeding ponds can not be provided except by private enterprise.

"Scattered over the country are hundreds of springs, brooks, reservoirs, ponds, etcetera, which are perfectly suited to the rearing of fish from fry to fingerlings, or larger," said Mr. Leach. "These are not available for operation by the bureau, but local parties desirous of improving fishing can take them over, make necessary improvements, and establish a fish nursery. They are provided with the initial stock of small fish, and are expected to stand in the role of foster parents of these fish until they are ready to distribute six months or a year later. This constitutes the kernel of the co-operative fish-cultural plan.

"The advantages of the scheme can be readily seen. The sportsmen have at hand a stock of fish whose number and size are known. Incidentally they generally receive much more generous allotments for stocking a nursery than could be furnished under ordinary application. While they are put to the expense of maintaining the nursery and caring for the fish, they would directly or indirectly bear a portion of this expense anyway, and frequently local conditions permit the rearing of fish in a private nursery at a reduced cost.

"Further advantage to the sportsmen lies in the fact that they can distribute fish at their leisure and are not forced to the hurried dumping which is the case when a shipment of fish is received from the hatchery and must be planted within a few hours. The distribution may be spread over several weeks and based upon a well thought out plan so that every stream may receive its quota of fish."—*Science Service.*

Herdng Reindeer By Airplane

NEW uses for the airplane are being found almost every day. The latest, and perhaps the most interesting from an economic point of view, is that of herding reindeer in Alaska, where Uncle Sam is breeding a huge meat supply for the future. Ralph Lomen, pioneer of the Alaskan reindeer industry, says that it is not practiced regularly, but that it seems feasible. "Our head herdsman," said Mr. Lomen, "went out recently in an airplane and accomplished as much in two hours as would have otherwise required a week with six men."

Elevator Service In Smoke Stacks

MAN-CARRYING elevators inside 225-foot smoke stacks are features of the new million-kilowatt-capacity East River generating station being created from the existing plant. Seven smoke stacks will tower above the roof of the power house. They will each be 22 feet in diameter, constructed entirely of steel plates riveted together.

Heretofore the inside of steel smoke stacks have been lined with brick, because moisture, gathering where the plates are riveted together, causes corrosion and destroys them. But the designers of the East River station decided that a brick

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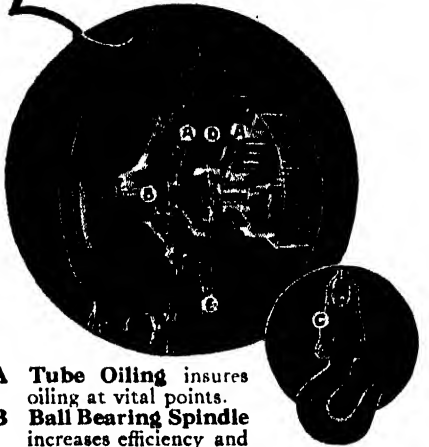
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lining was not necessary. Instead, they had the inside of every seam in each stack welded smooth, to allow no place for moisture to gather. Thousands of linear feet of welding protect the vulnerable places where plates are joined together.

The elevators permit thorough and safe inspection of the insides of the stacks. Each elevator consists of a steel platform running along guides and suspended from a cable over a sheaf at the top of the stack. When not in use, the elevators rest at the bottom of the stacks, below the openings in the sides where the smoke enters from the boilers.

Steel ladders are built outside the stacks to provide another means of ascent. The workmen climb between ladder and stack, rather than outside, since this gives them a feeling of security.—*Science Service.*

"Siamese" Twins Joined at Head

TWO-HEADED monsters abound in legend and story, but Guy's Hospital, London, has a unique record of twins with but a single head.

Twin girls joined at the tops of their respective skulls were admitted to the hospital when they were four days old. In spite of the continuous skulls each acted independently of the other, one being able to sleep while the other cried, according to Dr. H. C. Cameron, physician in charge of the children's department of the hospital, who reported the case to the medical journal, *Lancet*.

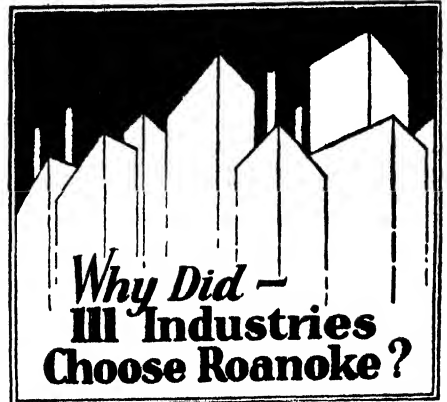
The long axis of the joined babies was not on the same plane, so that when number 1 was laid flat on a bed, number 2 howled lustily until the mattress was inclined so that a comfortable position was reached. Since from the nature of their deformity the children would always have to recline, thus becoming a ready prey to infection, and since one was failing rapidly, it was decided to try to save the stronger by separation. Unfortunately, however, it was found on operation that the cerebral spinal fluid was continuous in the two crania so that death resulted instantly.—*Science Service.*

Patriarchal "Ages" Were Ages of Tribes

METHUSELAH did not live 969 years. The clan or tribe he founded lasted that long, bearing his name until it died out or was absorbed into another primitive tribe. Similarly, Adam's individual age was not 930 years; that was the "lifetime" of his tribe.

This suggested explanation of the apparently unnatural ages of the Biblical patriarchs was advanced before the American Philosophical Society at its annual meeting in Philadelphia recently by Robert P. Field. Mr. Field was led to this hypothesis by a parallel case which has been more fully elaborated in Old Testament history. Israel was the name of a person. The tribe he founded was also called Israel, and the name has finally been extended to mean a whole nation or race. In this sense, Israel has lived something like 4000 years, and has beaten Methuselah's record four times over.

According to Mr. Field's interpretation, the apparently advanced ages at which the patriarchs became fathers of their oldest sons were in reality the ages at which the families of these sons left the patriarchal clans to become the nuclei of new clans on



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their own account. Thus Adam did not beget Seth at 130 years of age; Seth was born a good deal earlier, and had a numerous family of his own. What happened during Adam's 130th year was not the birth of a son, but the birth of a clan. Adam died at 130, and, at the settling up of his affairs, his eldest son went forth and founded the clan of Seth, leaving the clan of Adam still to flourish for 800 years, until the name finally died out. The same history repeated itself many times, as recorded in the genealogical chapters of the Book of Genesis.

Mr. Field's theory would call for a re-dating of the Old Testament, and a great extension of the time over the 4004 years allowed by Archbishop Ussher's chronology. Thus the antediluvian period was from 8000 to 10,000 years, and the postdiluvian period from 4000 to 6000 years. Abraham is dated 2090 B.C. and the Flood between 9000 and 6500 B.C., while Adam lived at about 20,000 to 15,000 B.C.—*Science Service*.

Body Metabolism Believed Same in All Races

BODY metabolism proceeds at practically the same rate, be its exterior covering black, white or brown. This conclusion was announced at the American Philosophical Society in Philadelphia recently by Dr. Francis G. Benedict and Morris Steggerda of the Nutrition Laboratory of the Carnegie Institution of Washington as the result of the study of several races.

Measurements made on some Chinese and Japanese students and also at Mount Holyoke College, said Dr. Benedict, indicated a very low rate of metabolism which was at first attributed to some racial factor. Further studies, however, made in the island of Jamaica on brown and black individuals, showed that their metabolism was essentially the same as that noted in whites in the United States. The tropical climate apparently did not produce any appreciable effect.—*Science Service*.

Enormous Fossil Bird From Wyoming

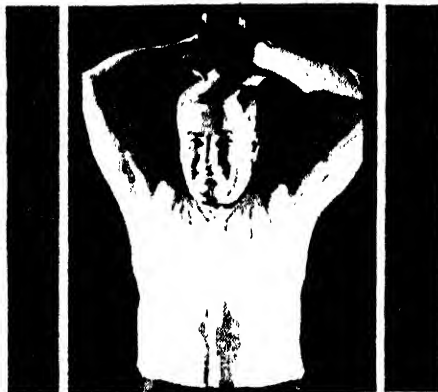
THE prehistoric rocks of Wyoming have yielded up parts of the skeleton of a huge flightless bird that lived on this continent many hundreds of thousands of years ago. The fossils were found last summer, but their discovery was announced for the first time recently before the meeting in Philadelphia of the American Philosophical Society, by Professor William J. Sinclair of Princeton University.

The bird was similar to other giant extinct birds found on this continent, but constitutes a new genus, which has been named *Omorhamphus*. It had no wings, and was a ground-dweller like the modern ostrich. Instead of the specialized club-like toes of the ostrich, however, it had more primitive feet with short curved claws. In some respects it resembled the moa of New Zealand, which became extinct during the memory of the native tribes of those islands.—*Science Service*.

Working as College Course Popular Education Method

WORKING in an industry while studying engineering is becoming a popular method of higher education in America, Prof. W. H. Timbie of the Massachusetts

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Institute of Technology told the National Education Association recently.

"Although Dean Herman Schneider introduced the co-operative plan into America, at the University of Cincinnati, over 20 years ago, the possibilities of the plan are just beginning to be sensed by the colleges and the industries of the country," he said. "Already 18 engineering schools have co-operative courses, with over 5000 co-operating pupils enrolled. The result is that the theoretical instruction at college has been vitalized by the fact that the student knows from experience the practical application in the engineering field of the theories he is learning.

"Industry also appreciates the better training which the co-operative students receive, as is evidenced by a study of the positions held by graduates of the co-operative courses in electrical engineering at the Massachusetts Institute of Technology. This study shows that the average salary of these graduates increases at a rate 55 percent faster than that of the average engineering graduate of the country."—*Science Service.*

New Ship's Boom

A NEW ship's boom, or crane, invented by a Portland, Oregon, man, is modeled after the booms used in the construction of tall buildings and has several advantages over old styles.

Due to its long reach, it may be used to



The long-armed ship's boom

load two or three holds at one time. Hitherto a hoisting engine was necessary for each of several shorter armed booms, an engineer was required for each of these, and the booms were often at rest while loads were being stowed properly. One man operates the new boom, which can be operated continuously because while cargo is being stowed in one hold, loads can be lowered into others.

When a ship is being loaded from railroad flat cars, switching charges may be reduced by the use of this boom since its long arm will reach over the cars on four tracks. Spotting of cars on one track next to the ship is unnecessary.

While the ship is at sea, the boom is lowered to the deck where it takes up very little space, leaving a clear deck for the storage of lumber or other cargo.



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THIS is the life of Henry Christophe, King of Haiti, a son of African slaves who rose to heights never attained by any other black man. The story is beautifully written and flows with a swing and rhythm seldom found in biographies. \$2.65 Postpaid

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Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

A Design Is Not a Product

THE new type of molded inlaid linoleum floor covering which looks like vari-colored tiles is familiar to everyone. It is made with a press upon which suitable ribs have been placed. This press is applied before the linoleum is cured.

The Armstrong Cork Company, which owned the patent for making it, recently sued the W. and J. Sloane Manufacturing Company for infringement. The defendant's contention that the patent was invalid was upheld.

"Molded inlaid linoleum having a vari-colored pattern is old in the art," Judge Bodine, of the New Jersey Federal District Court, rules. "The novelty, if such there be, is in depressing the lines around the design.

"As to the method claims, there seems no patentable novelty. A depressed design upon leather, wallpaper and countless other materials is, of course, obtained by hand pressure or machine, when the article upon which the design is to be placed is in a somewhat softened or plastic condition. That is all the patentees do.

"The leather upon which the bookbinder has depressed a design is still leather. The Florentine and Venetian leather workers, for a long time, have understood the design advantages obtained by using both color and depression to obtain a pleasing result. Books bound in Florence or Venice are books as much as the humble work of the village binder.

"A difference in design cannot make a new product. A new and beautiful design is protected as a design, but its application to an old product cannot make a new product."

Patents in Soviet Russia

FINDING it necessary to progress that inventors be encouraged, the Union of Russian Soviet Republics have been operating a patent system with increasing success for more than three years. The patent laws are patterned largely after those of Germany, with which country the Soviet Union has a special patent agreement. Russia does not belong to the International Patent Convention.

Patents are issued to foreigners the same as to Soviet citizens; they also may be granted to corporations when it is difficult to determine the work of individual inventors in industrial organizations. The term of a patent is 15 years and there is no filing fee. Taxes are paid only after the invention has been exploited. After five years the inventor must show that he is working his patent; otherwise he may be obliged to license other persons to work it. The inventor may lose his patent if it is proved that he is using it only as a means of keeping the invention out of general use.

In the last three years 22,023 patents were issued by the Russian Patent Office. Of this number 3988 were filed by foreigners. Germans applied for 2666 of these, Americans for 245, Englishmen for 210, Dutch-

men for 170, Swedes for 137 and Austrians for 109.

In the same period of time 3876 applications for registration of trademarks were received. Of these 1779, including 891 of foreign origin, were registered.

The Original Vacuum Cleaner

ADVERTISING has so accustomed us to various names in association with universally used inventions, that the names of the real originators often are unknown to us. Who invented canned vegetables, the electric flat iron, or safety pins? It would be interesting to know.

Take the vacuum cleaner, for example. Did you know it goes back to 1869? The earliest patent we have been able to locate was issued in June of that year to Ives W. McGaffey, of Chicago. The term "vacuum cleaner" had not yet been devised and the

the heavier particles are brushed down into the carpet.

"To obviate these difficulties is the object of my invention, the nature of which consists in the employment of a strong current of air, produced by mechanism, and so controlled as to take up the dust and dirt, and carry the fine particles into a porous air-chamber, so constructed as to allow the air to escape, while the dust is retained."

A grooved wheel or pulley was fixed on the handle near the end. This was turned by hand, a rope turning a smaller pulley on the end of a fan shaft. The air to supply the fan-blast was admitted through a passage which widened out at its front and tapered down, so as to receive the air in a broad thin sheet. The dirt was caught in a cotton bag very much like those on the machines in use today.

Cuckoo Trademarks

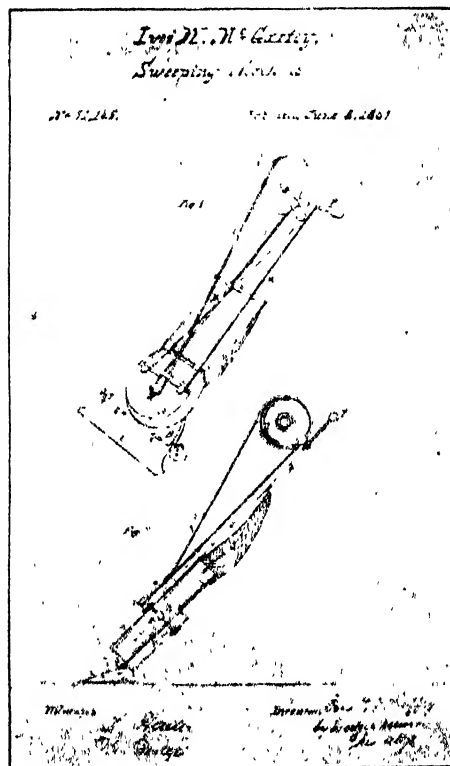
SOMETIMES a manufacturer will adopt a particular trademark because he hopes to cash in on the good will built up by another manufacturer who uses a similar trademark. Such a manufacturer is likened, by Judge Hutcheson, of the Federal Court for the Southern District of Texas, to the cuckoo bird, whose well-known idiosyncrasy it is to lay its eggs in some other bird's nest.

The judge's remarks are elicited in his decision enjoining the Listerated Company from using the trademark "Listerated" on hair tonics and dandruff remedies. Action was brought by the Lambert Pharmacal Company, which has been using the trademark "Listerine" since 1881. The originator of the Listerated product said he adopted the trademark because he saw the word on chewing gum. A druggist had told him that "he had better put some Listerine in his preparation or Lambert would get him," and that thereafter he put some Listerine in his product.

"In addition to the views expressed that the use of the word 'Listerated' is a technical, statutory trademark infringement," says Judge Hutcheson, "I think the evidence amply sustains plaintiff's contention of unfair competition, and that only a blind man can fail to see that defendant has deliberately set out to pirate plaintiff's reputation and its name; to reap where it has not sown, and like the cuckoo, to lay its eggs in the nest of another bird.

"With the entire field of unappropriated names open to it, it selected the name 'Listerated' because it knew that the very word carried with it a suggestion of prophylactic cleanliness, and that this suggestion had been created for the word by plaintiff's advertising. Such a practice cannot be too vigorously condemned.

"Plaintiff insists, and I agree with plaintiff, that defendant's tonsorial infant, conceived as it was in business iniquity, cannot be cleansed of its original sin by the simple device of sprinkling over each bottle of it, ten drops of Listerine, pro-



"Dust and dirt in dwelling houses is a source of great annoyance to all good housekeepers," said the inventor in his patent application

inventor called his device an "improved sweeping-machine." In his patent specification, McGaffey explained it as follows:

"The accumulation of dust and dirt in dwelling-houses is a source of great annoyance to all good housekeepers, a large portion of the dust being so light that the ordinary process of sweeping sends it flying into the air, so that it is difficult to control or expel it from the room. The use of a broom or brush on carpets is objectionable, for it wears off the lint and fiber in fine particles, and creates a cloudy dust, while

phylactic and cleansing as they are, but that what is needed here is a true regeneration, with a new christening under a new name."

"Inventions Wanted"

MEN who would be inventors frequently write to us asking what to invent. They are inventive, they tell us, and if only someone would tell them what to originate they would set to work and originate it. From time to time lists of inventions wanted appear. The best known of these is "What's Wanted," assembled by the British Institute of Patentees. A few of the items listed will give an idea of the nature of all of them:

A motor engine which does not need de-carbonizing.

A silent lawn mower.

An invention that will transmit the words spoken into a receiver to a typewriter, which will automatically reproduce.

A sign-writer's brush which can be loaded with a fair amount of paint to save dipping in pots for almost every stroke taken.

A means of producing electrical energy in reasonable quantities other than by mechanical motion.

A photographic negative which can be developed in daylight.

Something to prevent fluff under beds.

A bath-room bolt which can be bolted from the inside but which, in the case of emergency, could be quickly released by pressing a button at the bath, at the same time ringing an emergency bell.

An unpuncturable pneumatic tire.

A magazine hammer which will supply a nail every time the hammer head is struck on the job and drive the nail with one blow and with the use of one hand only.

The transmission of speech by light.

An onion peeler which will do away with the watering of the eyes of the person peeling the onion.

Some of the things called for already are in use. Even so, of what use are such lists? The originator, Sir William Bull, believes they are largely inspirational. "Many discoveries," he reminds us, "were made during the long medieval and apparently (I say, apparently) hopeless search for the Philosopher's Stone."

Our observation has been that a definite economic need is at the bottom of every successful invention. There often is more ingenuity required, we believe, in finding exactly what to invent than there is in actually making the invention.

One Form of Protection Only

WHEN a man originates a new design or device he sometimes has a choice of methods of protection. For example, it is possible that the same emblem could be protected as a commercial print, a label, a design, or a trademark. Having chosen which form of monopoly he desires, however, the owner cannot later elect another form so as to give his monopoly a longer life.

This principle is well illustrated in the recent application of Ernest Blood for a design patent for a hosiery ticket. The application was rejected on the ground that previously he had registered the same design as a label. In upholding the decision of

the Examiner, the Commissioner of Patents declares:

"There is no difference in contemplation of law between the label-design and that involved in this proceeding: the design in each case is the same. The design is not entitled to double registration, once as a label-design and again as a design for a hosiery ticket. Such a course would result for all practical purposes in an extension of the design monopoly."

"The applicant was entitled to apply for a patent for the design as a hosiery label, or he might complete the label and register the design, so completed, as a label. He could not do both. He elected to pursue the latter course, and has obtained the protection thereby assured to him, and he is bound by that election."

In Praise of Research

WE hear much of the immense amount of research work done by great manufacturing corporations. The question arises: Who pays for it? How and why the ultimate consumer bears the cost was explained recently by Albert K. Davis, vice-president of the General Electric Company in charge of its patents. In a formal statement to the United States Senate Committee on Patents he said in part:

"One of the greatest benefits of the patent system is that it makes possible the development and commercial introduction of inventions. A striking illustration is the Curtis steam turbine, which

is today developing a large part of the electric energy used in this country at a great saving in fuel.

"Before Charles G. Curtis brought this matter to us he had, I am informed, been obliged to spend large sums of money in experiment and development. We took it up and worked on it for years, and before we had received a dollar of profit we had invested in it over 3,000,000 dollars, which was a very substantial part of the capital of the company in those days."

"The only way we could get this money back was by adding a 'development charge' to the cost of the turbines, which we thereafter built, until that 3,000,000 dollars was liquidated. If it were not for the patent system our competitors could have copied our turbines, without spending any substantial sums in development, and could have undersold us."

"There are some inventions which can be developed and exploited by the traditional poor inventor, to whose exertions the world, as we all know, owes a great deal. But it is becoming more and more the case, as the demands of modern civilization increase, that inventions require the expenditure on development of sums of money greater than any ordinary inventor can hope to supply by his unaided efforts."

"If he goes to capitalists to ask them to furnish the money for the development, the only thing that he has to offer is the probable profits from the patent. If he goes to a manufacturing company and tries

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Aeronautics

FLYING MACHINE—Of the helicopter type, equipped with two oppositely rotating propellers mounted as a unit to lift the machine directly upward, for a take-off, as well as the usual propeller for forward movement. Patent 1665091. W. H. Goynes, 1011 2nd Ave. East, Tillamook, Ore.

Pertaining to Apparel

KNIT SCARF—Wherein the edge at the sides and ends, is tightly knit, and the center is of loose knitting in imitation of hand knitting. Patent 1666819. A. F. Goetz, c/o Morgan Knitting Mills, 577 South 10th St., Newark, N. J.

SLIPPER—Wherein an ornamental edge is provided at the junction of the sole and upper, whereby the stitching used in the sole is protected against ordinary wear. Patent 1667629. H. Friedman, 33 34th St., Brooklyn, N. Y.

DEVICE FOR SUPPORTING TIES—Made of wire and acting as a spring, secured on the shirt collar stud, for receiving a tie, without any portion of the device appearing. Patent 1667679. J. Roura, c/o C. Chassevent, 11 Boulevard de Magenta, Paris, France.

SQUARE FOR DESIGNING GARMENT PATTERNS—Which will present usual measurements, and in addition designs for both the body and sleeves, and the position of the construction lines on a pattern. Patent 1667646. A. Gingall, 67 W. 46th St., New York, N. Y.

Chemical Processes

PAINT—Composed of finely powdered carbide sludge, coloring matter and linseed oil, will withstand relatively high temperature and may be used on wood or metal. Patent 1664341. L. M. Wise, 201 Erie St., McKeesport, Pa.

Designs

DESIGN FOR A HOLDER FOR A FOUNTAIN PEN OR THE LIKE—Patent 74802. H. B. Quain, 382 No. 16 St., San Jose, Calif.

DESIGN FOR A CURTAIN-POLE END OR SIMILAR ARTICLE—Patent 74781. J. O. Crawford, c/o John Kroder & Henry Reubel Co., 107 E. 17th St., New York, N. Y.

DESIGN FOR A SHOE—Patent 74789. T. J. Fitz Harris, c/o Franklin Simon & Co., 38th St. and 5th Ave., New York, N. Y.

DESIGN FOR A DOLL—Patent 74720. G. Gormany, 1908 Shattuck Ave., Berkeley, Calif.

DESIGN FOR A CURTAIN-POLE RING—Patent 74721. J. O. Crawford, c/o J. Kroder and H. Reubel Co., 107 East 17th St., New York, N. Y.

DESIGN FOR A CURTAIN-POLE BRACKET—Patent 74722. J. O. Crawford, c/o J. Kroder and H. Reubel Co., 107 East 17th St., New York, N. Y.

DESIGN FOR LACE—Patent 74817. B. A. Ball, c/o American Textile Co., Pawtucket, R. I.

DESIGN FOR A SIGNAL LAMP—Patent 74859. I. Alexander, 543 East 182 St., New York, N. Y.

to get it to exploit the invention for him, the patent again furnishes the only hope which the company has of getting its money back.

"I am persuaded that the benefits to the public due to this result of our patent system are much greater than is generally realized."

Altering a Patented Machine

TO what extent can a manufacturer alter a machine? An unusual phase of this frequent question arose recently in the suit in which Judge Lowell in the Massachusetts Federal District Court held that the George Close Company did not have the right to change a caramel wrapping machine which it had purchased from the Ideal Wrapping Machine Company in order to accommodate larger-sized caramels.

The patent sued on covers a machine for wrapping small cubes of candy. It wraps 200 caramels a minute, which is more than double the output of any prior machine. Its two main parts are a cutter table and a wrapping wheel. The cutter table is a circular disk with knives at fixed intervals. The wrapping wheel is a vertically revolving disk with pockets to receive the severed pieces of candy.

The particular machines used by the George Close Company were guaranteed to wrap pieces of candy 1 by 1 by $\frac{3}{8}$ to $\frac{3}{4}$ inches at the rate of 200 per minute. After the company had been selling candy for some years, it found that its market was seriously interfered with by a piece of candy $1\frac{1}{4}$ by 1 by $\frac{3}{4}$, which was manufactured by the Ideal Caramel Company. Application was made to the manufacturer of the wrapping machines to change them over to wrap candy of the larger size, but this the manufacturer refused to do. (It developed that two of the officers of the machinery company had bought a controlling interest in the Ideal Caramel Company, which proceeded to wrap candy of the larger size.) The Close Company had the necessary alterations done by a machinist.

"The rights of a buyer of a patented machine have been settled by a long line of cases," Judge Lowell finds. "He may use it until it wears out, and may repair it also; he may not, however, rebuild, or, as it is usually called, 'reconstruct' the machine. Difficulties arise in determining the legal limits between repair and reconstruction. The test is whether the identity of the machine is preserved by the repairs. If they are so extensive that the result is a new machine, the legal limit has been passed and the forbidden realm of reconstruction has been invaded.

"If we test the case at bar by the criterion of identity we shall find that the machines lost their identity and became different machines, as they were so reconstructed as to be capable of wrapping an entirely different size of candy from that which could be wrapped by them when in their original condition."

In Praise of the Patent System

EDWIN J. PRINDLE, president of the New York Patent Law Association, recently made an address in which he declared that in a large measure the tremendous strides forward which civiliza-

DESIGN FOR A CURTAIN-POLE BRACKET OR SIMILAR ARTICLE—Patent 74864. J. O. Crawford, c/o John Kroder & Henry Reubel Co., 107 East 17th St., New York, N. Y.

DESIGN FOR A JEWELRY SETTING—Patent 74888. F. C. Joseph, 1316 Morris Ave., New York, N. Y.

DESIGN FOR A COMBINATION CONTAINER AND PICTURE FRAME—Patent 74889. H. A. Kretschmer, 401 No. Leavitt St., Chicago, Ill.

DESIGN FOR A BOOK-END OR SIMILAR ARTICLE—Patent 74955. T. S. Woodward, Leetonia, Ohio.

Electrical Devices

ELECTRICAL DOUGH-IMPRINTING MACHINE—For the imprinting of dough blanks prior to baking, the dough being placed in biscuit sized pockets and the dies mechanically brought into contact therewith. Patent 1665196. M. Collis, 165 King St., Charleston, S. C.

VACUUM TUBE—In which a single tube having one filament can be used in place of a plurality of tubes in a multi-stage radio set. Patent 1666833. W. A. Rhodes, and D. Bellar, 388 Central Ave., Brooklyn, N. Y.

RADIANT-ENERGY COLLECTOR FOR AERIALS—Star-like elements made from a single piece of copper and attached to an ordinary outdoor antenna to make the same more responsive to electrical vibrations. Patent 1666834. W. A. Rhodes, and B. Bankoff, 388 Central Ave., Brooklyn, N. Y.

VACUUM TUBE—Capable of use other than that of a detector because it is capable of greatly amplifying the electrical signal impulses impressed thereupon. Patent 1666858. A. H. Jahn, 3521 Butler St., Pittsburgh, Pa.

ELECTROMAGNETIC DETECTING DEVICE—A compact apparatus which may be carried around, is highly sensitive, and by which oil lying beneath the earth's surface may be accurately detected and charted. Patent 1665662. C. E. Godkin, R. F. D. No. 1, Box 145, Hayward, Calif.

Of Interest to Farmers

DRAWBAR SHIFT FOR TRACTORS—Which is adapted to be manually shifted particularly when the tractor is plowing on a hillside and turning the furrow down the hill. Patent 1665133. V. L. Gibson, Route No. 1, Salem, Oregon

BOIL-WEEVIL DESTROYER—A wheeled framework which is movable along rows of plants, an agitator for dislodging insects, and pans of destroying liquid for catching insects as they fall. Patent 1665960. C. A. Heilmann, Skjelskor, Denmark.

HARROW-DISK SHARPENER—And means for supporting a harrow disk in frictional contact with a grinding element in order that the peripheral edge may be sharpened. Patent 1665954. T. Fox, Spalding, Nebraska.

HARROW ATTACHMENT—Including a pair of goosenecks secured to the rear bar of the harrow at an angle, and a blade attached thereto acting as a scraper. Patent 1666778. J. M. Harlan, Dayton, Wash.

CORN-HUSKING MACHINE—For stripping the ears from a row of standing stalks, husking the ears, separating the stripped ears and loose husks, and dumping each. Patent 1666796. H. V. Schuler, Box 391, Spencer, Neb.

GUARD FINGER FOR MOWING MACHINES—Which has means for contacting with its supporting bar and with adjacent guard fingers so as to prevent play or slipping and consequent breakage of blades. Patent 1667627. E. S. Fisher and E. R. Mendrop, Hollandale, Mississippi.

Of General Interest

PORTFOLIO—Or brief case, wherein one or more readily accessible pockets are presented for

tion has taken since the end of the 18th century is due to the American patent system. He said in part:

"Because of the increased productability which the American inventor has made possible, the average American workman has an attractive home, electric lights, a bath, an automobile, a radio and a victrola; and he has the leisure to enjoy them, and this is so notwithstanding that he has to compete with cheap labor abroad.

"At least two concerns in this country spawn automobiles like fish, at the rate of several thousands a day, and each more complete, automatic, and convenient than the best car that money could buy a few years ago, either here or abroad.

"In a recent article by Examiner W. I. Wyman, of the Patent Office, he enumerated the principal inventions produced by Americans in the various single decades since the establishment of our patent system. In the decade from 1840 to 1850, there were produced the reaper; vulcanized rubber; the sewing machine; and the telegraph, inventions all of incalculable value.

"From 1880 to 1890, the inventions of the first importance produced by American inventors are too numerous to enumerate here. I mention only the following: the wax phonograph record; the Westinghouse quick-acting air brake; the Janney car-coupler; the transparent photographic film—forerunner of the movie; the recording adding machine; the linotype type-bar casting machine, which greatly reduced the cost of printing; the single-type composing machine, setting the individual type themselves; the half-tone process of printing pictures in books and newspapers, almost universally used; the Tesla split-phase induction motor; the automatic knot-tying harvester—replacing 7 out of 8 men; the incandescent light; the transformer; the steam turbine; the electric furnace; the polyphase electric motor; the cash register; the trolley car; and electric welding.

"Although Americans are all of European stock, and therefore are not naturally more inventive than Europeans, yet, it is a fact that more than two thirds of all the inventions of primary importance which have been made since the establishment of our patent system were produced by American inventors. Of the wonderful development which I have outlined, but a small part would have occurred, if it had not been for the inducement of the American patent system.

"I, therefore, express my profound belief that our patent system has been the primary factor in making the United States foremost among the nations in agriculture, inventing, and manufacturing. While, of course, there were other factors, the patent system was by far the most potent one.

"The American patent system is the most marvelously effective economic instrumentality ever devised by man. It is producing inventions at such a rate that we more than half expect to see an announcement of a new invention every time we open our morning paper.

"We, therefore, who are engaged in its administration, may feel that we are taking part in one of the most vitally important activities of our political economy, and may derive corresponding inspiration and satisfaction from our work.

"And because that instrumentality has such wonderful results, let us lawyers guard it from any experiments with changes in its principles, and confine attempts to improve it to matters of simplification of procedure."

holding folders, capable of ready removal, and with means for preventing disconnection. Patent 1668385. L. Danziger, 42 West Broadway, New York, N. Y.

WATER SILENCER—Readily assembled or taken apart, can be attached to any ordinary faucet and will silence and filter the flow of water and prevent splashing. Patent 1668382. S. B. Merkel and E. Dobrowsky, 168 W. 96 St., New York, N. Y.

BREWING UTENSIL—For brewing such beverages as tea, coffee or the like, with means for suspending the substance to be brewed either immersed or above the water. Patent 1664226. A. E. Silver, 8504 76th St., Woodhaven, N. Y.

CHIMNEY CAP—A cap or cowl, whereby the interior of the chimney is protected against rain and foreign matter by inclined deflecting members which cause a draught. Patent 1664315. R. P. Orr, 1091 Parkwood Blvd., Schenectady, N. Y.

COMPACT FOLDER AND EJECTOR—For vanity cases, wherein a manually actuated ejecting spring is utilized to produce a movement of the compact when the catches have been released. Patent 1664301. W. G. Kendall, 118 Market St., Newark, N. J.

CHAIR—A non-folding sheet metal chair so constructed that a number may be piled, or nested, in direct vertical juxtaposition for storage purposes. Patent 1664356. L. Dellart, 176 Russell St., Brooklyn, N. Y.

SMOKERS' STAND—Associated with an ash tray, for supporting cigarettes, matches or other analogous packed articles, disposed in tiers and different planes to facilitate their removal. Patent 1663601. A. Kappenberg, 4030 7th St., Bayside, L. I., N. Y.

NON-REFILLABLE CARTON—For radio tubes or analogous articles, which protects the tube, and admits the testing of the contents without removal of the carton seal. Patent 1664350. A. R. Cappiello, 96 East Moshulu Parkway, New York, N. Y.

PARTITIONING DEVICE—Capable of a wide range of adjustment so as to provide partitions or compartments in a drawer or other receptacle just the size or shape desired. Patent 1664465. F. A. Purchas, McGraw, N. Y.

GASOLINE-STORAGE-TANK FILTER—For sub-surface gasoline tanks, which when coordinated, will make it possible to remove the discharge pipe without digging up or disturbing the surrounding ground. Patent 1665106. A. P. Moran, 139 Main St., Ridgefield Park, N. J.

CANDY BOX—Simulating a log cabin, with lock controlling means for the roof, or lid, and means for starting and stopping a musical box hidden from view. Patent 1664464. F. A. Purchas, McGraw, N. Y.

PROCESS OF MAKING DOUGHNUTS AND OTHER FOOD PRODUCTS—Wherein dough with a suitable amount of shortening is squeezed through a compressible container into a mold, wherein the cooking the shortening forms a thin crust. Patent 1663719. J. Morley, 2706 West View Drive, Los Angeles, Calif.

COMB—In which is formed a groove at the base of the teeth for an absorbent cord, the cord absorbs moisture in drying the hair, and is removable to provide a self-cleaning comb. Patent 1665184. H. H. Hutchings, 220 W. 42nd St., New York, N. Y.

CABLE GUARD—For use on highways or bridges, wherein the cable is so supported that it will prevent vehicles from striking the posts, thereby avoiding danger. Patent 1664821. I. E. Quist, c/o Highways Dept., Warren, Tenn.

SAFETY-RAZOR HANGER—For supporting the razor, carrying new blades in such manner that they are easy of access, and providing a receptacle for used blades. Patent 1663875. R. Doner, 303 Segur Ave., Toledo, Ohio.

JELLY-BAG HOLDER—Including two telescoping rings, between which the marginal section of a bag may be clamped, and suspended there-

from, and means for supporting the rings. Patent 1664658. C. P. Blazer, Sutico, Wash.

POSTING TRAY—Designed for securely holding a plurality of ledger sheets in adjustable and separable vertical position to facilitate reference thereto, and posting thereon. Patent 1668198. C. B. Harrison, 434 So. San Pedro St., Los Angeles, Calif.

MUD-LADEN FLUID FOR OIL AND GAS WELLS—Comprising finely ground iron filings, borings and scale, by which the flow of gas, oil or water can be controlled and the sealing up of well sides effected. Patent 1663492. L. Chamberlain, 2550 East 9th St., Los Angeles, Calif.

JEWELRY CASE—So constructed that when closed the articles will lie flat, and when opened the articles will be moved to an inclined position for display, without removal. Patent 1666001. T. Catala, Hudson Terrace, Englewood Cliff, N. J.

COOKING, FREEZING AND STORING RECEPTACLE—Which provides a dead air, or vacuum, space in the walls and cover, whereby approximately the same temperature may be maintained for a protracted period. Patent 1666012. C. S. Humphrey, c/o Manhattan Can Co., 882 3rd Ave., Brooklyn, N. Y.

EGG HOLDER—For transporting eggs, stamped from a single piece of pasteboard, and provided with means for supporting the egg at the center as well as top and bottom. Patent 1665420. E. E. Pinkerton, 4428 Hermitage Ave., Chicago, Ill.

ARTICLE CABINET—Or rack, for the convenient housing and storage of umbrellas, overshoes, or the like, whereby drainage water is collected while the articles are drying. Patent 1665986. S. R. Side, c/o Rubin 1516 54th St., Brooklyn, N. Y.

SHADE-CORD HOLDER—In the nature of a button, which permits coupling engagement of a shade cord with the shade without knotting or tying the cord. Patent 1665953. W. J. Foster, 2540 Boulevard, Jersey City, N. J.

METAL BASE FOR TIMBER POLES—A cylindrical metal sleeve which fits tightly around the pole below ground to prevent decay, and extends sufficiently above to protect from grass fires. Patent 1665995. A. J. Wiley, Hydraulic Engineer, Boise, Idaho.

WINDOW CLEANER—In which two telescopic sections, with cleaning heads are spring pressed against fabric pads, for simultaneously cleaning the opposite sides of a window pane. Patent 1666060. K. Horiata, c/o M. C. Kauffman, 911 Park Ave., New York, N. Y.

TELLERS' CAGE—For banks, by which a teller is enabled to receive and deliver moneys from his window by a rotatable table thus minimizing injury and possible theft. Patent 1663681. E. E. Cronenweth, 721 East Broadway, Glendale, Calif.

WINDOW CLEANER—A forked frame which supports and clamps cloth-holding elements to the inner and outer surfaces of a pane, for simultaneously cleaning both surfaces. Patent 1666782. J. J. Kilbride, cor. Mountain & Montague Aves, Scotch Plains, N. J.

FLATIRON—Which is co-extensive in length with the width of the ironing board, and may be readily pushed forward onto the piece being ironed, without directly lifting the iron. Patent 1665295. E. D. Campbell, 675 19th Ave., San Francisco, Calif.

Hardware and Tools

COMBINATION WASHING TOOL AND SWAB—Adapted for cleaning the flow surface of a well of drill cuttings, mud, paraffine or other sediment which would retard the production of the oil. Patent 1664288. A. Boynton, 1800 San Pedro Ave., San Antonio, Texas.

DIVIDERS—So constructed that a full length pencil or a small stub will be securely retained in position, and may be rapidly adjusted with one hand. Patent 1663855. J. L. O'Connor, 1 Dermott Court, Portland, Maine.

CASING SPEAR—For pulling casing or pipe from wells, which cannot become jammed in operation, may be released and re-engaged without drawing the tool to the surface. Patent 1664363. W. H. Harvey, Water Valley, Mississippi.

WRENCH—In which the movable jaw, instead of reaching around the shank is secured to one face thereof, which allows of greater freedom in shaping the shank. Patent 1663920. A. W. Peterson, 1533 E. 74th St., Chicago, Ill.

PIPE COUPLING—Which facilitates the connecting of well casing sections, firmly holding the sections at the joints against longitudinal and internal as well as external stresses. Patent 1663702. W. D. Himes, 4109 So. Main St., Los Angeles, Calif.

WRENCH—Which may be quickly adjusted by loosening a wing nut, sliding the jaw, and setting the wing nut, when set the wrench will not slip. Patent 1666879. V. Barton, Cadillac, Mich.

BELT-APPLYING TOOL—Whereby one person is enabled with its aid to engage a heavy belt with a pulley, at high tension, the tool is readily adjustable. Patent 1666789. G. W. Pobanz, c/o Davis & Taylor, Attys, Geneseo, Ill.

COMBINED BOLT AND NUT LOCK—Having a locking member adapted to seat within grooves on the bolt and nut, whereby they may be locked without loosening by vibration. Patent 1666608. F. L. Sarazin, Route 1, Dubuque, Iowa.

NAIL SETTER—For holding a number of nails, adapted to be manipulated by one hand for setting, while the other hand is free to drive the nails with a hammer. Patent 1665669. E. F. Malouf, 325 "D" St., Marysville, Calif.

Heating and Lighting

MELTING POT—For melting linotype metals, from which the dross can be readily discharged from the pot, and collected without polluting the surrounding atmosphere with poison. Patent 1664779. L. W. Jones, 108 West 1st St., Los Angeles, Calif.

FLUID-FUEL FURNACE—Having both oil and gas burners, and means for controlling the fuel supply so that the oil and gas burners can be used together or separately. Patent 1663713. H. V. Leahy, c/o Leahy Mfg. Co., 1804 East 8th St., Los Angeles, Calif.

AIR CIRCULATING AND HEATING APPARATUS—Which may be employed in cold weather as a heater, and in warm weather for circulating the air in a room to cool the same. Patent 1666816. P. R. Falk, 30 Gay St., Elmhurst, N. Y.

Machines and Mechanical Devices

WASHER-SETTING MACHINE—For automatically and simultaneously setting an entire series of washers on the pegs in a rubber heel mold, for encircling the nail holes. Patent 1664846. M. G. Bertons, 76 Hazel St., Glen Cove, L. I., N. Y.

PLATE VALVE—Which is rotatably supported, and on which relatively little wear will take place on the contacting surfaces, easily opened or closed against relatively high pressure. Patent 1664306. W. A. Milam, Box 55, Seymour, Texas.

EXCAVATING BUCKET—Wherein reeving of the closing cable is simplified, the entire organization compact, and a diminished height makes it possible to work in close quarters. Patent 1664359. A. Grout, c/o Warner & Sullivan, Sault Savings Bank Bldg., Sault Ste. Marie, Mich.

PROCESS FOR THE MANUFACTURE OF A CELLULOSE PRODUCT HAVING THE APPEARANCE OF WOOL—Which consists in producing cellulose filaments by mechanically drawing a solution of cellulose through a coagulating bath until their molecular stability is assured in undulated form. Patent 1664319. A. Pellerin, c/o C. Blety, 2 Boulevard de Strasbourg, Paris, France.

PUMP JACK—Which is so constructed and organized as to impart to the polish rod of the pump a true rectilinear movement. Patent 1664364. W. G. and K. R. Jensen, 117 No. Oak St., Nowata, Okla.

APPARATUS FOR SEALING PACKAGES—Which thoroughly cements the entire surface of all open flaps on a carton, and in a single operation seals both the outer and inner wrappings. Patent 1662341. H. Schwarz, 426 Brannon St., San Francisco, Calif.

VARIABLE-SPEED PULLEY—Including a pair of pulleys of radially adjustable segments, and so constructed that the contraction of diameter of one automatically effects the expansion of the other. Patent 1663414. A. H. Mize, c/o Leslie N. Flood Union Bleachery, Greenville, S. C.

CUTTING OR SLICING MACHINE—Especially adapted to produce battery separators from small blocks or waste lumber, also for producing sheet-like veneer stock as used in the construction of berry baskets. Patent 1665131. E. R. Ferrari, Box 45, North Bend, Oregon.

OIL GRATE AND SEAT—Adapted for use in hydraulic oil presses, wherein the oil channels may be increased in size and easily cleaned without removing the seat or other parts. Patent 1665123. W. A. Wilhelm, 2819 Wilbarger St., Vernon, Texas.

FLOW METER—Comprising a multiple-bladed low pitched screw, connected to a shaft acting directly on a recording mechanism for accurately measuring the rate of flow of a stream. Patent 1665141. C. P. Mayer, 420 Westfield Ave., Elizabeth, N. J.

CASING ELEVATOR—For handling oil well casings, a hinged connected collar securely encircling and gripping the casing eliminating twisting, slipping or other injury in the elevation. Patent 1664461. G. A. Montgomery, Box 2293, Dallas, Texas.

VENDING MACHINE—For wrapped candy rolls, cigars, or other analogous articles, the machine being operable by depositing a coin, and the merchandise vended one at a time. Patent 1665989. W. P. Smith, 292 Park Ave., Newark, N. J.

SAND-TESTER PUMPS—Adapted to be reciprocated in an oil well to remove oil sands for testing, thus eliminating the practice pipe setting and bailing. Patent 1665967. G. F. LeBus, c/o LeBus Rotary Tool Works, Electra, Texas.

PERFORATED CASING—For oil wells, constructed to allow the ready influx of oil from the oil sands, yet protect the casing against the wearing action of the sand. Patent 1664734. D. N. Brundy, 1708 No. Raymond, Pasadena, Calif.

CASTING MACHINE—Which affords facilities for subjecting molten metal to pressure, and at the same time causes an air suction before and during the pressure. Patent 1666843. F. N. Brown, Jr., 407 Mills Bldg., El Paso, Texas.

DERRICK—Having a novel form of gudgeon for the lower end of the mast, and also coordinating means to guide the hoist cable at the mast top. Patent 1666857. F. Hunt, 941 East 156th St., New York, N. Y.

Medical Devices

STRESS BREAKERS—A coupling device which connects a tooth engaging member with the artificial denture and compensates for the natural movement by a ball and socket connection. Patent 1665975. N. A. Oscher, 274 Livingston St., Brooklyn, N. Y.

Musical Devices

BRIDGE FOR PIANO ACTION—Of such character and design as to permit one to substitute it for the ordinary bridge, should the latter become broken, with accuracy and ease. Patent 1663538. H. E. Chute, 3401 South Flower St., Los Angeles, Calif.

Prime Movers and Their Accessories

CARBURETOR—Capable of not only forming an economical combustible mixture with air and gasoline, but wherein the heavier fuels may be employed with equal advantages. Patent 1663724. C. E. Palmer, c/o W. E. Barnhart, 511 Lyon Bldg., Seattle, Wash.

TRANSMISSION FOR SHAFTS—In which no gears are employed, which is noiseless, and will not require any oil for lubrication except the oil required for the shaft bearings. Patent 1664349. G. A. Burrow, c/o M. C. Gray, 1227 Riverside Ave. West, Spokane, Wash.

INTERNAL COMBUSTION ENGINE—In which each cylinder has a single port and means for automatically connecting the single port of each cylinder successively with the intake and exhaust. Patent 1665421. G. H. Roose, 1228 N. Court St., Carrole, La.

Railways and Their Accessories

COMPARTMENT CONVEYANCE CONSTRUCTION—Providing within the width and height limits of a standard car, a plurality of readily accessible compartments, affording separate seating, sleeping, and lavatory accommodations. Patent 1664294. E. Gugler, 101 Park Ave., New York, N. Y.

SPEED-CONTROLLING DEVICE FOR RAILWAY AND TRAMWAY TRAINS—So constructed as to automatically modify the braking action when the pressure of the compressed air of the brakes is inferior to the normal pressure. Patent 1665112. E. Rodolousse, c/o C. Chassevent, 11 Boulevard de Magenta, Paris, France.

AIR-BRAKE VALVE—For a street car or like vehicle having an engineers' valve at opposite ends and a single line connecting the valves and the associated brake cylinder. Patent 1665586. S. J. Evans, Box 624, Princeton, W. Va.

TRIPLE VALVE—Particularly adapted for air brake systems, whereby the auxiliary reservoir is recharged without producing a brake release, whereby prolonged brake application can be effected when required. Patent 1663837. H. Hansen, Box 1252, Bisbee, Arizona.

TANK-CLEANING APPARATUS—For mixing a cleaning fluid with a heating fluid and then forcibly circulating the heated mixture against the inner walls of the tank car. Patent 1666015. G. W. Land, 4015 Olive St., Vancouver, Wash.

Pertaining to Recreation

COMBINED PROTECTIVE AND SIGNALING DEVICE—For use by baseball umpires adjacent the home plate, whereby signals incident to the playing of the game may be disposed from a protected position. Patent 1663358. J. G. Stephenson, Box 582, Celina, Tex.

BASEBALL GAME APPARATUS—Comprising a game board having a surface representing a baseball field, even to the extent of providing ball pitching and ball batting devices. Patent 1662317. G. R. Livingston, 1336 Maple St., Santa Monica, Calif.

PUNCHING BAG—In which the bag structure is carried by a base structure capable of being shifted from place to place, while continually in condition for use. Patent 1665969. D. McNamara, 144 E. 17th St., New York, N. Y.

Pertaining to Vehicles

SIGNAL—In the form of a figure of transparent material, lighted by an electric bulb, from the inside, and adapted for connection to an automobile radiator cap. Patent 1666003. F. M. Crystler, 240 Hainbrook St., Belding, Mich.

TIRE BOOT—An internal blow out patch, which after being secured will remain affixed to the tire walls regardless of the heat and expansion of the tire. Patent 1666009. M. O. Haney, Iola, Kansas.

HEADLIGHT—Particularly adapted for use in connection with motor vehicles, for preventing "glaring" or upward reflections, the rays extending along parallel lines, without loss of light. Patent 1662322. B. E. Melton, c/o Morrison-Knudson Co., 1009 Continental Bank Bldg., Salt Lake City, Utah.

SHOE CLEANER—Especially adapted for automobiles, the scraper being spaced from the edge of the running board, while the bristles are arranged above, in a protected casing. Patent 1663972. C. Bruderlein, 9529 105 St., Woodhaven, L. I., N. Y.

WHEEL RIM—Of simple elements, adapted to be assembled on a wheel or demounted with ease, when assembled will possess strength and rigidity. Patent 1665092. T. L. Greenwood, North East Harbor, Nova Scotia, Canada.

DIRECTION INDICATOR—Which is electrically controlled, and operated by hand, to indicate to persons approaching or following the automobile when a turn or stop is to be made. Patent 1663971. J. D. Brower, Jr., Box 8, Nill Valley, Calif.

TIRE CARRIER—Having a longitudinally extensible and contractile supporting arm, and reliable and conveniently operable means for adjusting the length, and positively locking the arm. Patent 1665647. E. A. Walters, 560 So. Hazelwood Ave., Youngstown, O.

DIRECTION SIGNAL—Positioned to display signals at opposite ends so that motorists or pedestrians from the front or rear will be apprised of the driver's intended movement. Patent 1664810. R. C. Forbell, 578 Matio St., Los Angeles, Calif.

DIRECTION SIGNAL—Movable at the side of the vehicle to indicate right or left turns, controlled by the steering wheel, and returned to normal after turning the corner. Patent 1663859. D. W. Pratt, 1904 Eleventh St., Santa Monica, Calif.

ATTACHMENT FOR BUMPERS—Which operates in the event of a collision to shield the bumper against direct contact, prevents marring the surface, and cushions the shock. Patent 1665780. H. Hamburger, 943 Main St., Santa Paula, Cal.

TILTABLE AND DIRIGIBLE HEADLIGHT—So constructed that the beam of light may be thrown downward, and manually operated from the steering gear, when approaching another vehicle, yet rigidly supported. Patent 1666856. T. C. Holliday, 309 Edwards Hotel Bldg., Jackson, Mississippi.

WHEEL TIGHTENER—Which affords facilities for using a relatively small force to exert a relatively great pressure, to firmly secure a portion of the wheel felly to the associated spoke. Patent 1666829. J. Olson, cor. 7th & "D" Sts., Lewiston, Idaho.

LOCK—Which may be readily applied to a conventional motor vehicle to engage and hold the control levers, to preclude the unauthorized use of the car. Patent 1666786. O. A. May, 319 W. Gold Ave., Albuquerque, N. M.

RADIATOR ORNAMENT—In the form of a miniature airplane, which rises and falls according to the air current induced by the movement of the vehicle. Patent 1666806. N. L. Wright, 47 So. 12th Ave., Mt. Vernon, N. Y.

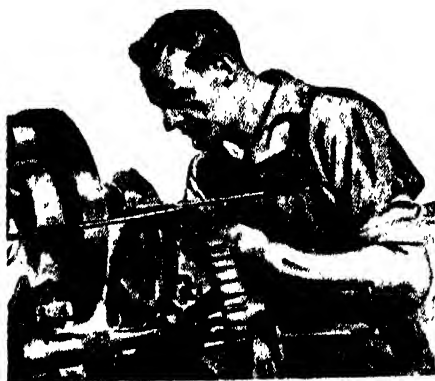
PNEUMATIC-TIRE—Which may be readily applied to the wheels, and will give an audible warning when the pressure within the tire has decreased beyond a definite amount. Patent 1666155. L. H. Unglesby, Box 274, Baton Rouge, La.

AUTOMOBILE HEADLIGHT—A non-glare lamp, which uses two sources of light, each focused at different portions of the road, illuminating far in advance and relatively near. Patent 1666151. R. B. Stiert, Box 164, Kingman, Kansas.

SPRING STEEL TIRE—Which is free from blow outs, the steel portion lasting permanently, and the rubber tread being removable, permitting new treads to replace old ones. Patent 1666873. F. S. Feldheim, 1534 Wilder St., Evanston, Ill.

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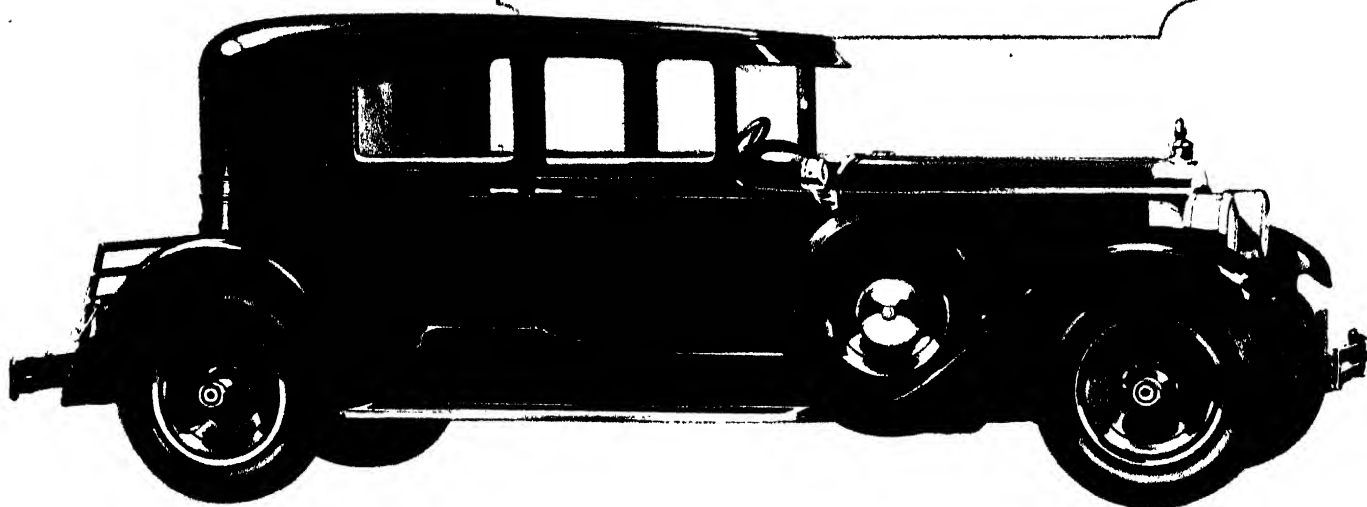
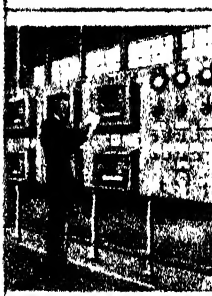
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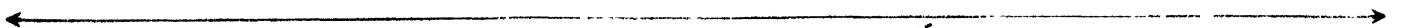
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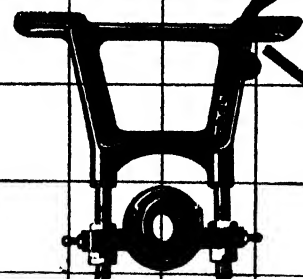


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Edited by ORSON D. MUNN

Eighty-fourth Year

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COVER

At about the time that Zane Grey's article on big game fish (see page 116) was accepted for publication, the editor was taking motion pictures of fish and fishing scenes off the coast of Florida. By a stroke of good fortune, his camera was trained properly just as a large sailfish was hooked, and subsequent feet of film recorded a series of spectacular jumps. Our artist, Howard V. Brown, has transferred to oil paints and canvas the thrilling beauty of these leaps, and the result is a fitting introduction to the interesting story which Mr. Grey has to tell. Incidentally, the sailfish illustrated was subsequently landed after a hard battle, and is being mounted for our editorial office as an inspiration to other anglers of the staff.



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Waste marks Industry for many a "hand-out". Why contribute the price of friction, break-downs, excessive maintenance and high depreciation? You don't have to. You can use Timken Bearings. Every branch of Industry is doing it. Prominent makers of every type of equipment are featuring Timken economies—entrusting their reputations to Timken results.

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TIMKEN *Tapered* Roller BEARINGS

Looking Ahead With the Editor

Australia's "Wild West"

IS the black of Australia's bush, hundreds of miles from even the smaller settlements, the lowest of human types? He wears no clothes; lives in a lean-to; and the family possessions consist of a digging stick, a wooden bowl, a tin can or two, a boomerang, a club, and a few stone knives. But in some ways he is quite intelligent according to the writer of an article to appear shortly. This is a story well worth the waiting.

Now Let Us Have the Truth!

WHAT'S all the furor about? It *has* been hard to understand, hasn't it? Naval limitations, cruiser size and strength, and related questions have brought forth such a flood of argument, resounding criticisms, lectures, newspaper "talk," inconsistent bombast, and even peace sermons, that most of us are "in the dark." The answer, authoritatively, concisely, and fully told, is coming in a new series. You won't want to miss it.

100,000 Years Old

RESEMBLING in some ways the famous Rancho-la-Brea tar pools near Hollywood, the McKittrick fossil quarry in California has given up fossils of the mastodon, camel, llama, lion, saber-toothed tiger, and numerous other animals. When collected and identified, they give a fairly good indication of what animal life must have been like in California 100,000 years ago. This "find," the subsequent excavations, and the method of preserving the fossils, is the subject of an early article.

Three Years Aft the Mast

THE Earth's magnetism is constantly varying. A ship, following Columbus' compass-course, would land at an island 660 miles southeast of where he landed. To keep track of these changes and learn facts concerning the ocean and its caprices, the non-magnetic ship, *Carnegie*, of the Carnegie Institution, sailed in May for a three-year 'round-about-the-world trip. An article now on hand tells interestingly about this trip and describes the equipment on the scientific square-rigger.

"I'll Have An Oyster Steak"

IT hasn't quite come to that, although the bivalves grown in Puget Sound are so large they are called "beefsteak" oysters. An article ready for release describes the development of this industry in that locality, tells how the "seeds" for this "farm" are collected in Japan, shipped, sown, grown in land prepared and surrounded by dikes, and finally gathered and shipped. In many ways the methods used are unique.

Every Issue Fully Illustrated

Read this magazine carefully. If you like it, you will like succeeding issues also. Better make sure of getting it regularly every month. A subscription, costing only four dollars, brings 12 issues to you.

Among Our Contributors

Robert A. Millikan



Dr. Millikan has become noted because of his remarkable researches. He was the first to weigh the electron—a piece of work for which he was awarded the Nobel Physics Prize. His more recent analysis of the cosmic ray has frequently brought him into public prominence rather more, perhaps, than many other scientists. The things he is finding out are likely, however, to be regarded by posterity as fundamental in the realm of scientific research.

Zane Grey

There is scarcely any necessity for introducing Mr. Grey except for the fact that this great novelist now writes a different kind of story. He is well equipped by experience, however, to tell about big game fish; for, besides being an author, he is an outdoors man, a sportsman, and is interested in museums.

G. Elliot Smith

Professor Smith is one of the world's foremost authorities on evolution, particularly that of man, and more particularly of man's brain, which is the main factor which differentiates man from his cousins, the living apes. He is the author of "Essays on the Evolution of Man" in which he sets forth his views more fearlessly than many scientists. He is a professor in the Institute of Anatomy, University of London.



Russell W. Porter

An architect, artist, arctic explorer with Peary and others, Mr. Porter took up optical work and developed the well-known screw-thread comparator. It is he who is co-operating with *SCIENTIFIC AMERICAN* in the campaign for the encouragement of astronomy through the making of amateur telescopes.

W. F. G. Swann

Recognized as one of the ablest physicists of the world, Professor Swann, an Englishman, was Professor of Physics at Yale until last year. He now directs physics research at The Franklin Institute in Philadelphia. His thorough work has always attracted widespread attention from other scientists.

Alundum, Solves Another Great Problem

The modern activated sludge system of sewage disposal requires Porous Plates of strength and time defying qualities. The electric furnace abrasive, trade-marked Alundum, the same basic material used in the making of grinding wheels, refractories, and slip-proof floors possesses the quality necessary for the successful performance of this service.

The great sewage disposal plant shown in the photograph is a typical installation of Norton Porous Plates.

Norton Company, Worcester, Mass.



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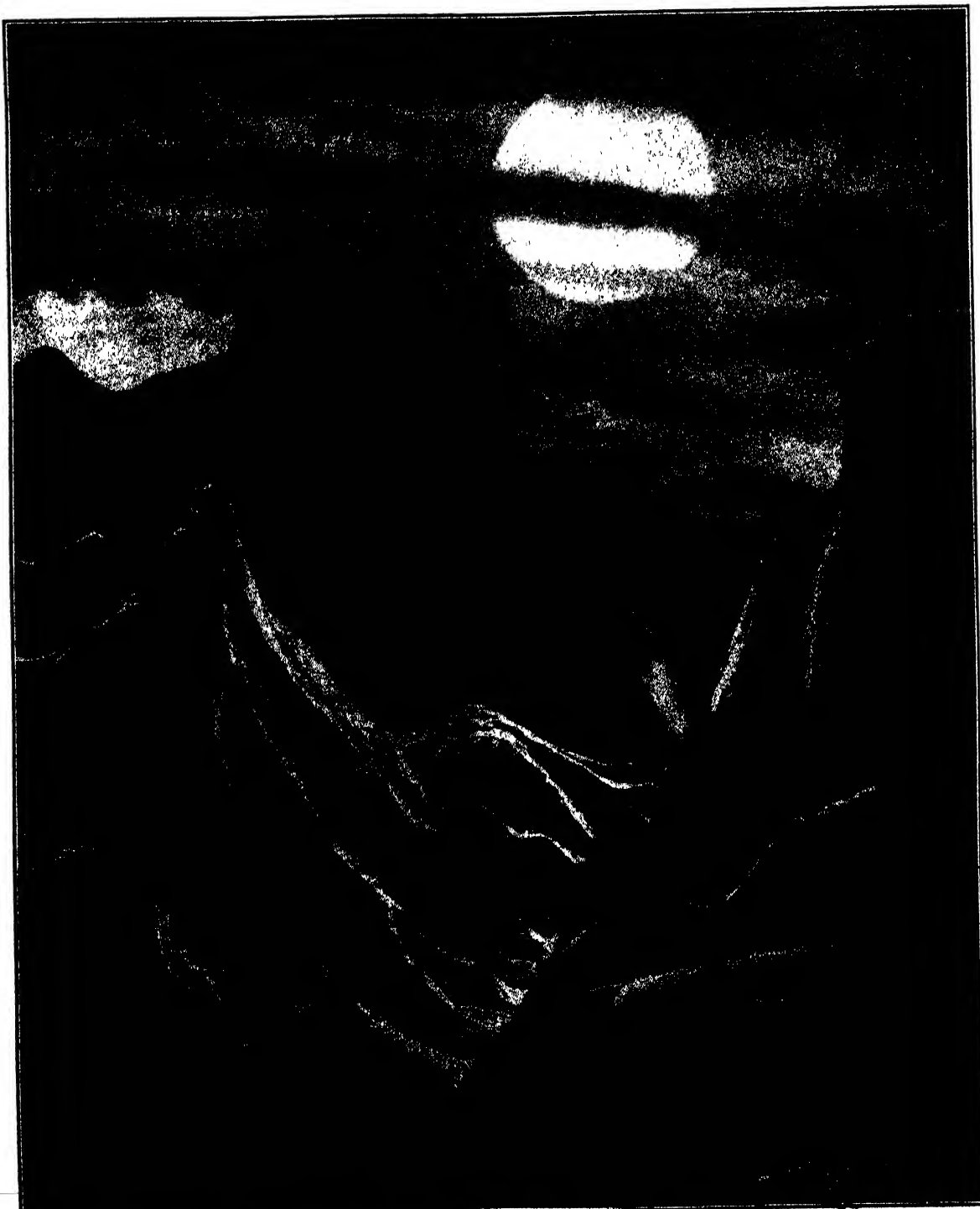
Refractories-Floor
and Stair Tiles



Elmer Sperry

ALTHOUGH Dr. Elmer A. Sperry is perhaps most widely known as the inventor of the gyroscopic compass and gyroscopic stabilizer for ships, he has been the recipient of many different honors in the broad field of engineering, industry and science. Born in western New York in 1860 and educated at Cornell University, he at once began the manufacture of electrical equipment and the development of his inventions, of which he has made more than 400. These pertain largely to naval purposes but include also electric beacons, high-intensity searchlights, the first electric chain mining machine (1888), various electro-chemical processes, machin-

ery for making fuse wires and an electric automobile. Numerous prizes, medals and decorations have been awarded him. He is a member and founder of the American Institute of Electrical Engineers and the American Electrical Society; a member of the American Society of Mechanical Engineers and other engineering and scientific societies. Pure science has recognized him by an award of membership in the National Academy of Sciences. In the picture reproduced above, he is shown standing beside "Metal Mike," the automatic steering apparatus for ships, which he invented. This device is used regularly on many vessels.

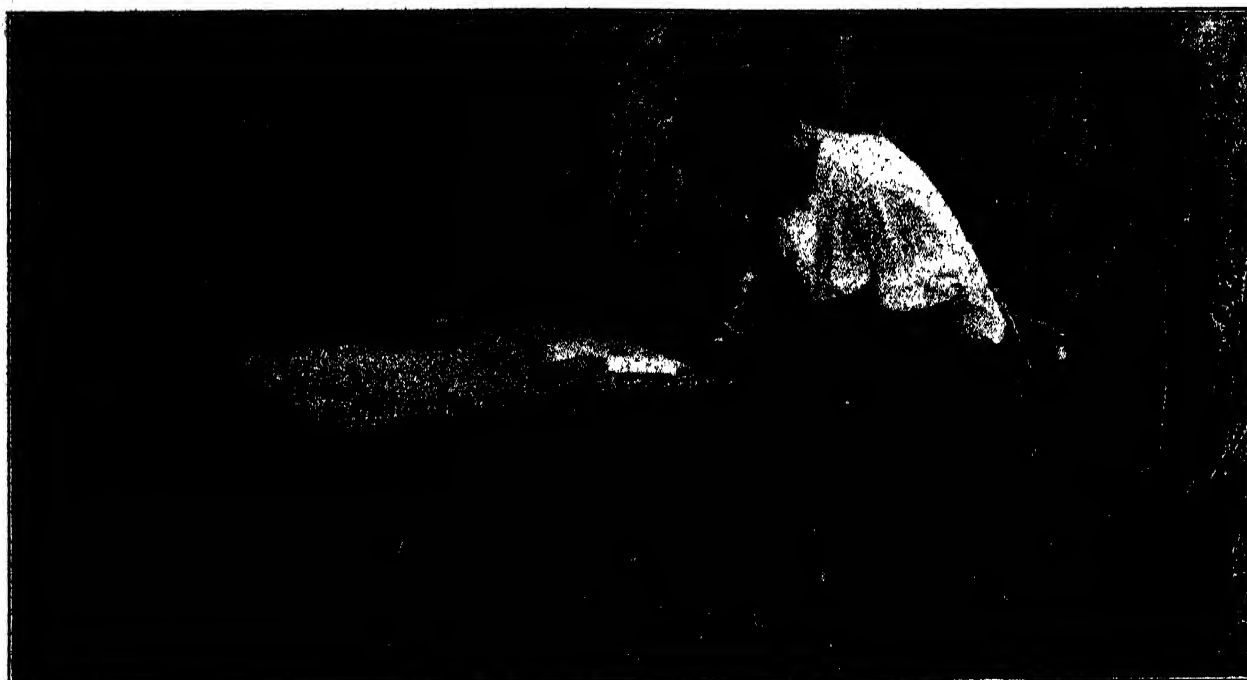


Courtesy Illustrated London News

Mercury—A Toasted World Where Lead Would Melt

MR. SCRIVEN BOLTON, an English amateur astronomer who is also an artist, has strikingly depicted his conception of a typical landscape on the planet Mercury where the Sun, lying only 35,000,000 miles away and much larger in apparent size than when seen from the Earth, is believed to shine perpetually and relentlessly on the same baked face of the little world. Radiometric measurements of this sunward face, made by Pettit and Nicholson of Mt. Wilson Observatory, who used extremely

sensitive apparatus similar to that previously described in the *SCIENTIFIC AMERICAN*, indicate a temperature of 660 degrees, Fahrenheit. Lead would melt! Surface markings have been detected on Mercury but their permanent, objective existence has never been definitely established. Mercury doubtless lacks, or nearly lacks, an atmosphere. In this it is much like the Moon which it resembles in size. A 150-pound man would weigh only $40\frac{1}{2}$ pounds on the planet Mercury—before he was broiled to a crisp!



Courtesy Bureau of Biological Survey

"BOB WHITE" GETS A BRACELET

Placing a band about the leg of a bird that has just been caught in a trap specially designed for these ground birds. A layer of cloth

placed underneath the wire mesh top of the cage prevents the birds from injuring themselves when they dart about trying to escape

Bird Secrets Revealed By Bracelets

Ornithologists Find the Answers to Many Important Questions About Birds By Banding Their Legs

By WALTER E. BURTON

Fascinating Co-operation

BIRD banding has a fascination all its own. As a hobby, it gives the amateur ornithologist much satisfaction to feel that he is helping to solve the question of how pest-birds may be controlled, and of how to protect game and useful birds. But think of the thrill that comes when he learns that a bird he banded has been found in some far-off, exotic clime!

The Bureau of Biological Survey will assist any person over 18 years old who seriously wishes to co-operate in this work. Instructions and serially numbered aluminum bands will be supplied. It is necessary, however, to obtain a license from the Bureau and, in some cases, from one's state government as well.—*The Editor.*

A FEW miles from the city of Cleveland, Ohio, there is a 100-acre farm which is said to contain more birds per acre than any other spot in the United States. This is the bird-banding station of S. Prentiss Baldwin, a business man who has turned ornithologist. He

also maintains a similar "laboratory" at Thomasville, Georgia, during winter months.

Mr. Baldwin, a pioneer in modern bird banding, has done perhaps more than any other person to place the capturing, marking, and studying of birds on a scientific footing. His methods of trapping, applying the bands, and keeping records of subsequent captures have been adopted by the United States Biological Survey and by other groups and individuals interested in the work.

ORNITHOLOGISTS both in Europe and America have known for a long time that many important scientific questions pertaining to all phases of bird life could be answered if it were possible to obtain a large mass of accurate information about bird migration and its attendant activities. Until two decades ago, the principal methods by which students attempted to throw light upon migration included observation of day migrants, collection of data concerning the arrival and departure of birds at certain places, and of biological, geological, and meteorological data influencing migration, and the like. Although much was learned from these activities, there

was the serious drawback that the information pertained to species and not to individual birds.

The method of bird banding deals with the individual bird, and with birds in large groups as well. The mere banding of a bird is in itself of no value unless that particular bird later is captured. The more frequently it is taken the better. In this way a large amount of information is accumulating, and

**A BIRD TRAP**

Mr. Baldwin taking a bird from one of his traps. He has handled thousands safely

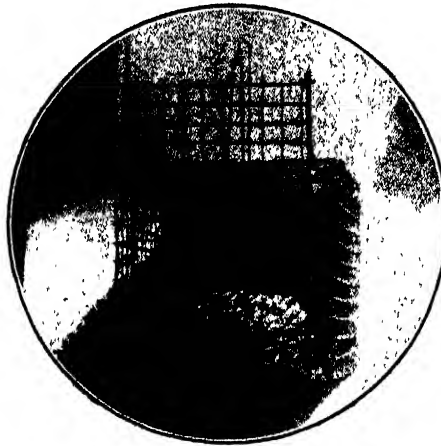
some day, no doubt, will be the means of providing complete, accurate knowledge concerning the movements of all kinds of birds; the actions of various individuals and species during different seasons; the cause of the enormously high rate of bird mortality; the reasons for shifting migration routes; the proportion of birds which return year after year to their former meeting places; and many other perplexing problems which will lead to a better understanding of our friends of the air when properly answered. Such knowledge, aside from its purely scientific value, already is showing in a practical way how migratory birds can be protected and how their usefulness as insect-destroyers can be maintained and increased.

THESE are but a few of the problems which ornithologists hope to solve by means of bird banding, according to Mr. Baldwin. The answers to some are being obtained slowly, while the solution of others will come only after many years of bird banding, with thousands of persons co-operating.

For example, the common crow presents a problem on which these bird-banding studies are beginning to cast a light. Sometimes crows are responsible for serious damage and must be controlled. Here a knowledge of their food habits and the periodic movements of individuals is required. Winter is the season in which they are most easily destroyed. Then it becomes important to know whether the individuals that make up the large winter roosts are the same as those guilty of depredations on crops of the locality in the summer. Only after many more recoveries will it be possible to know whether winter slaughter will protect the crops of the following season, or whether it will merely cut down the number of crows that would otherwise scatter to other localities in which

their good habits outweigh their destructiveness.

In the year 1710, a big, gray heron was captured in Germany. On one of its legs were several metal rings, one of them bearing an inscription which



ROBIN NEST TRAP

The weight of the bird on the nest operates a mechanism which drops the sliding door

stated that the bird had been caught in Turkey several years before. This, the first recorded instance of bird banding, caused a little local comment perhaps, and then was forgotten.

A hundred years later Brugmann, a Dutch naturalist, began to wonder about the winter activities of Holland's many storks. He captured a few of the lanky birds, placed rings about their legs, and then released them. He never saw his marked birds again, and concluded that they select a different home each summer.

At the end of the nineteenth century Mortensen, a Dane, captured and banded a number of birds of different species. He succeeded in recapturing many of them, thereby arousing the interest of other ornithologists. The practice of banding birds then began to spread, but was temporarily halted

by the World War. Scientific bird banding began in the United States when Leon J. Cole, of New York, founded the American Bird Banding Association in 1909.

One phase of early banding operations prevented the science from gaining wide popularity. It was necessary to kill the marked birds in order to recapture them and read the inscriptions on their bands. Mr. Baldwin, by devising several satisfactory types of bird traps, eliminated this drawback and brought about a complete revolution in banding methods.

"THE question is still frequently asked, whether bird-banding methods are cruel or harmful to the birds," Mr. Baldwin says. "Such questions can be answered best by explaining that every banding station becomes, in fact, a bird sanctuary. Here food and shelter, as well as safety from natural enemies, can be obtained. In fact, many birds regard a trap as a kind of cafeteria, and return hundreds of times during a season.

"There have been so few serious accidents to birds in my traps, or to the thousands which I have handled each year, that I can remember every fatality that has occurred in the many years of my experience. Such accidents have not averaged two a year—less than one accident to every thousand birds handled.

"It is one of the joys of this work that the ornithologist may handle and study great numbers of birds in a live, healthy condition, in normal colors not affected by the changes which come so quickly after death, and may make normal measurements and study natural attitudes and individual characteristics—all without destruction of a single life. For every dozen accidents that I have had with birds, I have been able to save actually hundreds of lives by proper care."



Courtesy Bureau of Biological Survey

BANDING A DUCK

A duck submits quietly to the process of being banded. Very large birds, such as eagles, require the undivided attention of several men



Courtesy Bureau of Biological Survey

HERRING GULLS

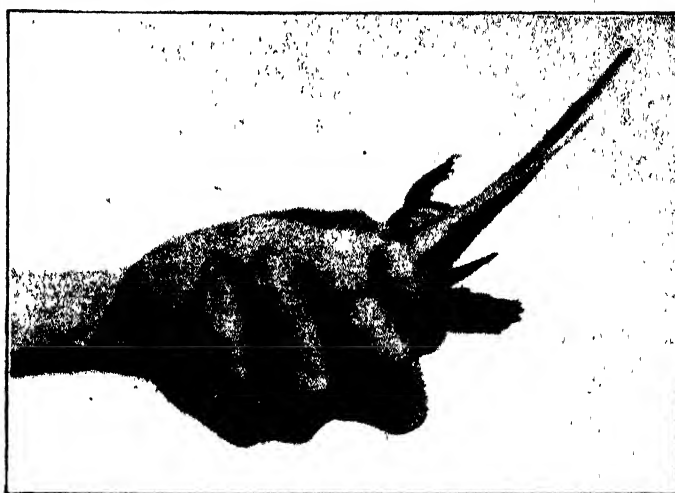
Placing aluminum bands on the legs of a large number of these birds captured off Hat Island, Michigan. It is fascinating outdoor work



Courtesy Bureau of Biological Survey

BEST POSITION FOR READING THE BAND

This position has proved most satisfactory for reading a band or inspecting the bird's markings. This brown thrasher rests quietly



HOLDING A BIRD FOR BANDING

By holding the bird in this manner, the thumb and forefinger are free enough to steady the leg. This mourning dove has already been banded

Much light has been thrown by bird banding upon the mystery of bird migration. One of the most unusual records is that of a common tern which was found floating on the Niger river in western Africa. On one of its legs was a band which had been placed there at a banding station in Maine!

A number of wild ducks were banded in Canada one fall. During the following few weeks many of them fell before hunters' guns. Reports of the various captures revealed that the birds, in their journey south, had taken two distinct routes, one along the Atlantic coast and the other down through the Mississippi valley. The last of the ducks was captured in far-off Trinidad, off the northeastern coast of South America.

THE direction of migration was for a long time a subject of much controversy. From casual observation of bird flight a theory that some species of birds migrated east and west, rather than north and south, was developed in North America and in Europe. In recent years, banding activities have shown that this theory is correct. For example, it is known that the marbled godwit of North America moves both east and west from its breeding ground, and that the thick-billed sparrow travels southeast, southwest and northwest from its breeding place. Ducks banded at Great Salt Lake, Utah, were found to migrate towards the four major points of the compass. Similarly, European woodcocks caught and banded at St. Petersburg, Russia, (now Leningrad) flew to three widely-separated winter quarters.

Many instances of extremely long bird flights are on record. For example, there is the arctic tern, the present record-holder of bird distance records. Each year it wings its way for 11,000 miles from antarctic ice fields to a nesting place not far from the North Pole. Several weeks later it returns south with the sun. The non-stop

record among birds is held by a little warbler, not much larger than a man's thumb, which speeds over the Atlantic ocean from Nova Scotia to the Lesser Antilles on the northeast coast of South America, a distance of about 2500 miles.

Mr. Baldwin has made a more intensive study of the house wren than of any other bird, largely because this bird is easily handled. On his farm, a wren has absolutely no privacy. Each wren egg, as soon as it is laid, is marked, measured, and weighed. These measurements are repeated from day to day during the incubation period.

As soon as the baby wren finds itself in the world outside the shell, it is given a number corresponding to that of the egg from which it emerged. This number is marked on its beak where it remains until the bird is old enough to wear a tiny aluminum bracelet. The growing bird is weighed daily, and careful watch is kept constantly for any peculiarities worth noting.

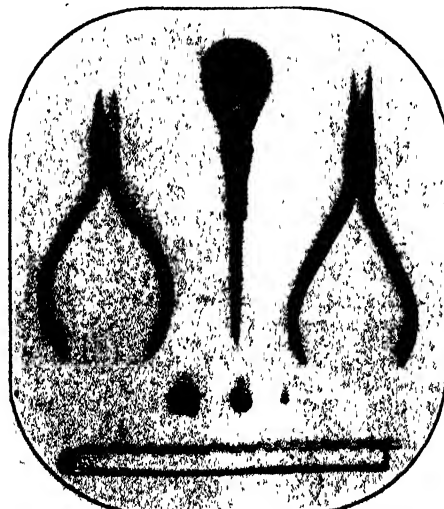
Mr. Baldwin, in studying the wren, found it necessary to keep a constant

record of the movements of the mother bird during the period of incubation. To accomplish this, he placed a delicate thermo-couple in the nest among the eggs. This was connected to a recording drum. When the temperature of the nest was raised by the presence of the mother wren or lowered by her departure, the fact was recorded on the drum in a continuous, wavy line.

Other important facts about wrens were unearthed by banding. It was learned that they make their winter home in Central America, and that they often return to the same summer home for several consecutive seasons.

BIRDS, like human beings, suffer from various kinds of ills, Mr. Baldwin has found. At his Thomasville station many chirping sparrows with diseased feet were caught. A nail or part of a toe would be missing, or an ugly, black sore would be present on a toe or foot. In some cases the feet would be bleeding badly. Occasionally a bird with an entire foot rotting away would be found, while other captives bore evidence, in the form of large scars, that they had suffered from the disease and then recovered.

Bird banding has a considerable economic value. It enables us to learn how to protect the wild birds which in turn devour crop-destroying insects. If there were no birds in the United States it would be only a matter of time until insects would threaten the food supply of the nation. It is only through activities of many banders, scattered throughout the country, that the movement will make rapid progress. If you find a bird, dead or alive, wearing a tiny aluminum bracelet, inform the United States Biological Survey of the fact, giving the number of the band, the kind of bird, place found, peculiarities, if any, and the like. In forwarding this information, you will be performing a valuable service for an important cause.



Courtesy Bureau of Biological Survey

BANDING EQUIPMENT

Pliers, band spreader, several sizes of bands, and the "safety pin" band holder

Our Point

Whose Responsibility?

DEATH, almost as certain as ultimate death, rapidly approaches the doorstep of five women in Orange, New Jersey. The women are condemned to lingering pain, suffering, then extinction. The cause—radium poisoning. Three of the five are married. One has two young children. Another has had two children, still-born. Science is impotent, medicine surrenders, radioactivity obeys relentlessly the blind laws of nature, death approaches.

Eleven years ago the story begins. Girls, jovial, light-hearted, sit in the factory of the United States Radium Corporation at Orange, doing piece work on watch dials, painting over the numerals with the radioactive stuff that enables you and us to see the time in the dark. They like their work.

The luminous preparation they apply so deftly is crystalline zinc sulfide with a dab of radium or mesothorium sulfate, mixed with gum arabic to make it stick. Radioactive material costs money, therefore it must not be wasted. The girls, in order to conserve it, pointed the tips of the brushes between their lips.

Since then we believe 13 of these girls have died.

Radium necrosis is the name of the sinister disease caused as a result of absorbing too much radioactive material in the body. Necrosis means "dead"—the bones die; other parts are affected. Of all the parts of the body the blood making apparatus, contained in the bones, seems to be the most sensitive to radioactivity. The insidious thing about this disease is that it lies latent for several years. Its causes are cumulative. Thus, by the time the light hearted girls discovered its first inroads all had left the work; some had married.

Who is to blame in a case like this? Who should pay? There are two sides to the matter, the legal side and the human side. The former aspect has been attended to. Under pressure of wise legal counsel, public opinion, conscience perhaps partly triumphant over stubbornness, the former employers have agreed to award—so it is stated—each victim 10,000 dollars outright and 600 dollars yearly during life; also medical costs. So much for the legal side.

But in a larger sense, who is to blame for the horrible blunder? Surely

the girls were not. Are the employers? Years ago they should have heeded the warnings of general scientific information. Evidently they took these warnings with a large grain of salt. The knowledge of the wrong they did thereby will ever be their cross to bear. Perhaps it is a case where the greatest share of responsibility is no one's. A new field—radioactivity—was being explored; still is, in fact. Man blundered into a pitfall. He creates many

Rejuvenation

VORONOFF, the Paris surgeon who performed gland grafting experiments on animals with a view to rejuvenation, recently has been investigated again. A British delegation of scientists visited the Voronoff experimental farm in Algeria and rendered the opinion that, while the evidences of rejuvenation provided by the famous bull "Jacky" support Voronoff's hypothesis, they cannot be accepted as final proof. The other experiments observed were not, in the opinion of the delegation, carried out in a thoroughly scientific manner.

As yet Voronoff, with his gland-grafting operation, has made very little headway in convincing science of the worth of his method. Steinach, who transplants nothing, but merely ties off a duct, has received much more favorable notice, largely it is true because he has conducted his experiments in a more disciplined, scientific manner than Voronoff.

Neither Voronoff nor Steinach has yet received in large measure the approval of science.

engines which he has not learned fully to control.

Will the Railroads Buy Wings?

TWO trends, one already taking place, the other placeable in the future, are likely to have robbed the railroads of all but a fraction of their passenger traffic before another decade has rolled around.

Since 1920, although the nation has increased approximately 13 percent in population, there has been a decline in passenger traffic of about one third—so we are told by Ralph Budd, president of the Great Northern. This is attributable to the private automobile and more recently the motor coach. In the west the decline has been even more notable than these startling

statements would imply, the number of passengers carried being only one half as large in 1927 as in 1920; and if one isolates the figures for a single state like Minnesota the corresponding reduction is two thirds. How will the loss of passenger revenue be allocated? Obviously to freight.

Mr. Budd goes on to point out that the trend is now toward the highway for local travel, while the long journeys continue to be made by rail. But do we now spy on the distant horizon the competitor who is destined also to take away a share of the remaining long distance passenger hauling? What of the airplane now coming on apace? How much longer will "the long journey continue to be made by rail?"

It is easy to wave aside the risky airplane as a serious future competitor with the railroads for average passengers, yet there was a time when stage coach owners similarly waved aside the "dangerous" railroads. Already the predicted wedge is entering. Overland journeys are soon to be made alternately by rail (at night) and by airplane (in daylight), the entire coast-to-coast journey thus being cut to 48 hours. How much longer will it be at the present rate of progress in commercial aviation before the entire journey will regularly be accomplished in a single leap, and with no more thought of the unusual than that which is now involved in taking a transcontinental express. To derive the answer, think back to the status of civilian aviation 10 years ago and then project a comparable progress into the future. Gigantic, undreamed of strides are inevitable.

Some of the railroads have displayed enough vision to get into the bus business before others should beat them to it. How will they be able to avoid embracing aviation in the same manner?

Specialization

A HIGH school youth recently wrote asking us to advise him the best subject in electrical engineering in which he should specialize. Naturally we couldn't, for, aside from the fact that we had no way of knowing either his particular aptitudes or anything about his individual nature, specialization should come only after years of study of a subject as a whole and a great deal of practical experience.

We are not so sure but that there is already too much early specialization. Too often a youth selects his subject

of View

when he is so young that neither he nor his parents and teachers have any idea what suits him best. His background of fundamentals may be poor in respect to the particular knowledge necessary for the attainment of his goal. Or his personality, propensities, traditions, all may combine to thwart him. The country is full of persons who either are misfits in their chosen professions, and consequently will never pass mediocrity, or have given them up entirely for something else, the simplest rudiments of which must still be learned at an advanced age.

In answer to such questions as that mentioned above, therefore, we should like to point to the medical profession as a standard. In this there are few misfits, and cases where a medical graduate has turned to some other work are extremely rare. Specialization comes only after completion of a broad and full college course, a three-year to six-year medical school course, and a period of a year or two as a hospital interne.

Of course it would be impossible to follow this procedure in some professions, literally at least, but we should like to see it applied to some extent in a great many. Too early specialization may result in mediocrity, and no one likes even to see much of that.

Golf!

NEWS item: "Golf for working-men at a cost of 25 cents for green fees, one dollar each for clubs and 15 cents each for balls has been inaugurated by George F. Johnson, shoe manufacturer of Binghamton, New York. . . . Golfing costumes will be discouraged, players being urged to play in their ordinary clothes. The company will furnish free golf shoes to all employees."

And as the golf season is with us, the wail goes up from the editorial sanctums, "Why, oh, why did we not become shoemakers!"

Street Gases

A WAVE of hysteria concerning the danger of poisoning of city-dwellers by automobile exhaust gases has been sweeping the country for some months past. Carbon monoxide gas, product of incomplete combustion, which prevents delivery of oxygen to the tissues of the body by combining with the haemoglobin of the blood, has been cited most often as the chief source of danger.

The United States Public Health Service has just completed a survey in which 250 samples of air were taken and tested from 14 large cities totalling 19,000,000 population. "The average of 141 tests made in city streets during peak traffic hours showed a contamination of 0.8 of one part in 10,000," says

Airplane Radio

RECENTLY, at the time of writing, the value of radio to the aerial navigator has been vividly demonstrated. By use of it, the *Southern Cross* was in constant touch with civilization throughout its long transpacific flight, and the tragic fate of Nobile's dirigible *Italia* soon was learned and rescue parties dispatched. True, the now historic *Spirit of St. Louis* flew thousands of miles, much of the time out of sight of land, and came through safely without the use of radio.

But the value of communication between aircraft and ground cannot be disputed. By means of it, the radio compass can be used to guide the pilot through the heaviest fog, and so aid in breaking the grip of the greatest enemy of the flyer; the pilot can be informed of approaching storms; and in passenger planes, the passengers can carry on their business correspondence with as much ease as if on board a palatial ocean liner.

The value of radio to the passenger-carrying steamship has been shown time and again, and laws are in effect that require the installation of radio apparatus on such vessels. Why cannot the same regulations be applied to aircraft that are used for passenger transportation? The usefulness of radio is being demonstrated every day by the planes flying to and from the huge airdrome in Croydon, England.

Let us look forward to a greater development of aircraft radio, and to the many benefits that it will bring.

the report. "Only 24 percent of all street samples showed more than one part in 10,000, and in only one place, a covered passageway, was there as much as two parts in 10,000. Samples taken inside buses yielded even lower concentrations."

A person can breathe an atmosphere containing four parts in 10,000 for several hours with only a resulting headache and some discomfort, while it takes a concentration as high as three

parts in 1000 to produce unconsciousness in 25 to 30 minutes and even this is not necessarily fatal if the victim is immediately removed to fresh air. From this it can be seen that the carbon monoxide exhausted from automobiles in our city streets presents no real health hazard.

Higher concentrations were found in garages, however, by the Public Health Service. There is a definite danger in letting a motor run for a short time in a roofed enclosure, and every car owner is warned not to let his car run and exhaust its gases in a closed garage longer than is absolutely necessary when driving in or out.

"Talking Movies"

EVIDENTLY the "talking movie" is with us to stay. A research branch of the Western Electric Company has recently announced that contracts have been completed which mean that the major motion-picture producers in the country will adopt one form or other of talking movies for use in their studios. This will mean that a great impetus will necessarily be given to the installation of special projection apparatus in theaters. The two main systems of taking and reproducing talking movies, Vitaphone and Movietone, have been described in this magazine. (June and September, 1927.)

Just how far the "talking" part will go in the composition of future motion pictures, still remains to be seen. As a means of presenting a complete synchronized musical score for the picture, the present systems leave little to be desired. When used in this way, the talking movie brings to the small theater the reproduction of large orchestras, without the expense.

But deliver us from the speaking voice of some of the present-day motion picture stars! What a sad disillusionment it is to see the sweet face and actions of a popular star, only to hear the coarse, harsh voice of the forewoman of the local hat factory when she speaks. Will the advent of the talking movie mean that a new set of stars will rise in the firmament of moviedom? Or will "ghost talkers" spring up in the industry, just as "ghost writers" have become so popular in current writing?

In any event, the end of 1928 should answer these questions, for it is predicted that by then there will be at least 1000 theaters equipped for presenting talking movies.

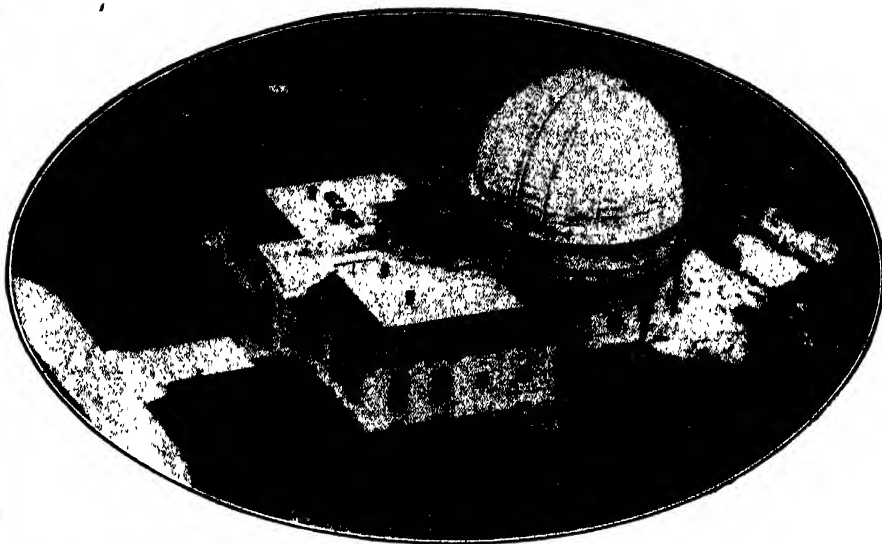
From the Scrap-book of Science—



P and A

NEW TRACTOR RECORD

Working in 12-hour shifts, the Battaglia brothers of Santa Clara, California, recently broke the New Zealand seven-day non-stop tractor record by cultivating with theirs without a mis-fire for a full 10 days



International Newswood

FOR WORLD'S THIRD LARGEST TELESCOPE

Perkins Observatory, Ohio Wesleyan University. Here will be housed the world's third largest telescope which was given by Mr. and Mrs. Hiram Perkins. The Bureau of Standards cast the mirror—the largest American-made optical glass. Mirror diameter, 61 inches; weight, a ton and a half



International Newswood

DE LUXE CAVE DWELLING

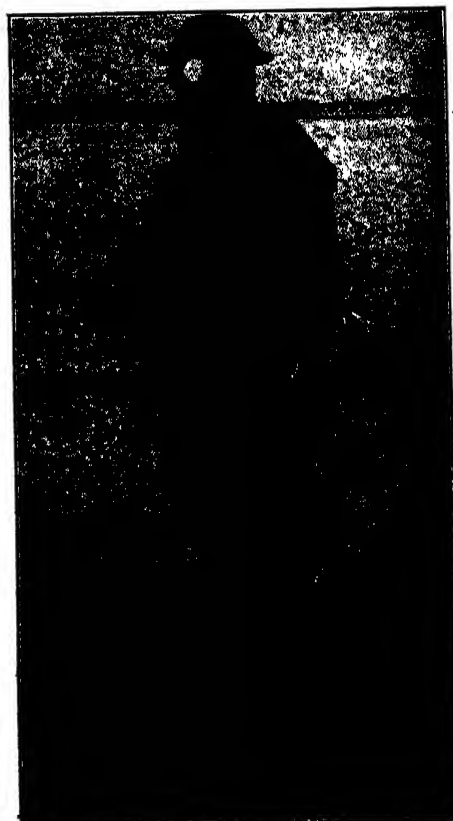
This cave house at Guadix, Spain, has two rooms, a fireplace, and a front yard for the animals. Note the chimneys and the "second floor" door and "veranda" above. Plaster and whitewash add a touch of distinction



P and A

"MOVIES" FOR AIR PASSENGERS

The Maddux Air Lines of Los Angeles recently projected a five-reel comedy in one of its planes while en route. The results were so good that the practice will be continued. Photographs show the projectionist and the motion-picture screen



Underwood and Underwood

GAS-PROOF UNIFORM

Ordnance officers of the United States Army have just given this new uniform a series of thorough tests. It not only protects the wearer from poisonous gases that attack the lungs but also from gases, such as mustard gas, which do their deadly duty by burning the flesh severely, thus rendering the combatant *hors de combat*. In this, the gas mask is supplemented by overalls, and gloves and boots of treated fabric which strap tightly to the wrists and ankles

Camera Shots of Scientific Events



P and A

SEWING MACHINES IN THE EVERGLADES

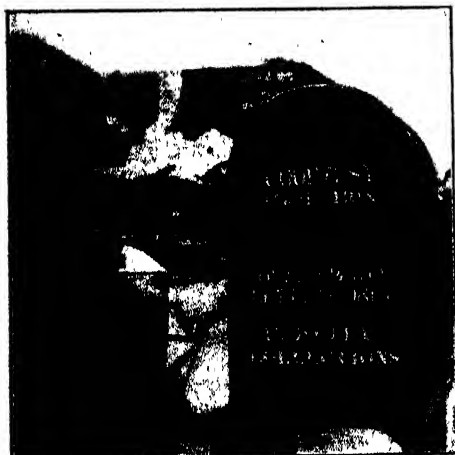
Gone are many of the ancestral customs of the Seminole Indians of the Everglades in Florida, but they stick to their colorful garments. Now, however, they use a modern sewing machine instead of old slow hand methods



P and A

GIGANTIC ELECTRIC SHOVEL

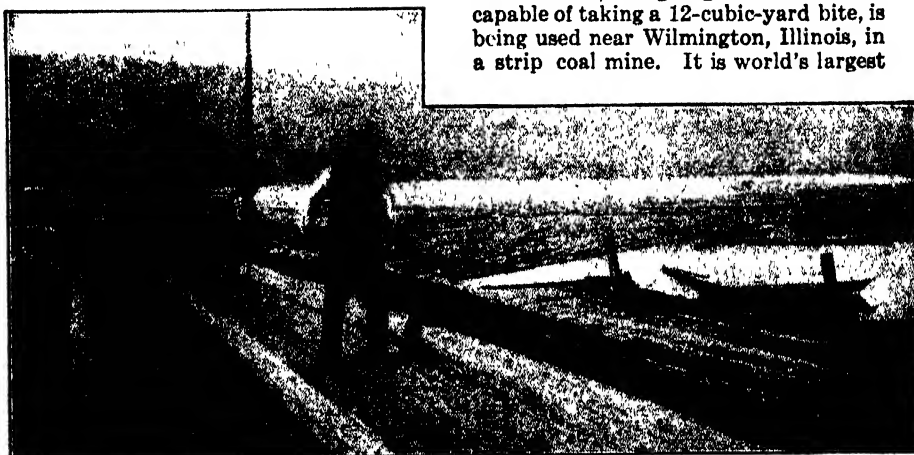
This shovel, weighing 875 tons and capable of taking a 12-cubic-yard bite, is being used near Wilmington, Illinois, in a strip coal mine. It is world's largest



P and A

CURB MAIL BOX

To relieve double parking of cars by persons who stop merely to post a letter, this mail box has been placed at the curb before the Oakland, California, post office. Extra height and a long handle to the slot cover add to the convenience of this courtesy box



RAFT MAKING

The wood pulp industry in Norway uses this method of making log-rafts. After sorting, the logs are carried by an endless chain to a point where they are pushed off and bound together with wire cables for the trip down a waterway to a port on the seacoast



CRESSON MEDALS

At a luncheon given recently in their honor, prominent industrialists, scientists, and inventors were presented with Cresson Medals by The Franklin Institute. The photograph shows from left to right: Henry Ford; Dr. Howard McClenahan, Secretary of The Franklin Institute; Charles L. Lawrance, the designer of the Wright Whirlwind motor which has made possible many record airplane flights; and Orville Wright, pioneer airman

Wide World



Wide World

AUTOMATIC DIALING DEVICE

Santos Pastor has just invented this device which eliminates the necessity of dialing a telephone connection through a central office. Regulated to secure 10 numbers by touching a button, it can be used to connect banks, et cetera, with their branch offices quickly



Painted under the direction of Henry Fairfield Osborn by Charles R. Knight. Courtesy American Museum of Natural History.

CAVE MAN OF THE NEANDERTHAL RACE, LE MOUSTIER CAVERN

Le Moustier Cavern is on the cliffs of the Vézère in France. The artifacts found in this cave were so representative of those of Neanderthal

man that the term "Mousterian" was applied to the known period of his existence, dated by many from 150,000 down to 25,000 years ago

Neanderthal Man Not Our Ancestor

An Early Controversy, Once Apparently Settled, Has Been Revived By a Recent Utterance

By G. ELLIOT SMITH, M.D., D.Sc., Litt.D.
Professor of Anatomy, University of London
Fellow of the Royal Society

IT has taken many years of discussion to make clear to some—although not all—of our critics that those of us who believe the human family to be descended from the anthropoid apes do not regard the gorilla or chimpanzee as our ancestor, but merely as a collateral descendant of the same original, although very remote, ancestral stock.

In other words, several million years ago the descendants of one group of the anthropoid apes, nearly akin to the fossil known as *Dryopithecus* (from the Miocene epoch beds of India) became separated into two groups, one of which, in the course of a million years or so, became gradually transformed into men, the other into chimpanzees and gorillas.

BUT the Miocene ancestor was neither a man nor a chimpanzee. Hence it would be absurd to say that man was the offspring of a chimpanzee, when the evidence is so clear that both were developing simultaneously from some much more ancient ape.

Much of the same sort of confusion has arisen with reference to the weird type of extinct members of the human family known to us (by the fossils that have been found from 1848 onwards)

under the name "Neanderthal man," because the first example of this strange sort of creature to attract the attention of scientific men was found at Neanderthal in 1856, although not made known to the public until the following year.

Most anatomists are now agreed that the living races of men are not descendants of Neanderthal man, but that

the latter was a collateral branch of the human family, so specialized in structure as to belong to a species altogether distinct from that to which all modern men belong.

Dr. Hrdlicka has revived the speculation that Neanderthal man is our ancestor. Perhaps it will be helpful if I set forth my reasons for disagreeing with his suggestion.

THE year 1857 witnessed the opening of a new chapter in the history of the human family. The public announcement of the discovery of remains of a strangely exotic type of man found near the entrance to a limestone cave in the Neanderthal between Düsseldorf and Elberfeld (in Rhenish Prussia) raised a controversy. It was, in fact, the first time that scientists were faced with the problem of the possibility that formerly there were men who did not belong to the species which includes all living men.

When the fossilized skull was first exhibited at a meeting of German scientists at Bonn, many of them freely expressed their doubts as to whether it was human, and not that of some extinct monster. Dr. Schaaffhausen, however, was convinced of its real significance, for he referred to the fact



Courtesy A. M. N. H., after Bode

LA CHAPELLE-AUX-SAINTS SKULL

The skeleton was found, almost complete, in a grotto near Le Moustier, in 1908

that the extraordinary form of the skull was due to a natural conformation hitherto not known to exist, even in the most barbarous races.

He had no doubt of its being a human relic which could be referred back to a more remote period, long before that of any of the living races of Europe, when animals such as mastodons, cave bears, rhinoceroses and other creatures long since extinct were roaming about Europe.

But these views were not welcomed by the majority of his scientific colleagues, for after a short time those who did not believe the fossil to be a part of some extinct animal that was not human, attempted to explain its peculiar features as due to some pathological process. This interpretation was urged with more emphasis by the famous pathologist Virchow. These facts are sufficient to emphasize the consideration that the original fossil differed profoundly from any other known human remains.

IN the year 1860 Sir Charles Lyell visited the site of the discovery and examined the original fossil skull. Moreover, he obtained from its discoverer a cast of it, which he brought back to England for Huxley to examine, so as to prepare for the new edition of his (Lyell's) book "*The Antiquity of Man*" a reliable report of this significant discovery. Huxley at once remarked that it was the most ape-like skull he had ever seen. He also admitted that the difference between it and the other fossil skulls which had been found in Europe was so vast, and the flattening so prodigious, that he imagined he must have fallen into some error in making his measurements. It is then quite clear, however, that it was merely an excess of caution which impelled him to refuse to regard it as an extinct species of the human family.

It must not be forgotten that this happened a few months after the publication of Charles Darwin's "*Origin of Species*," which created a tremendous sensation. Huxley was not only the leading champion of the cause of evolution, but he was also anxious to secure the support of Sir Charles Lyell. In

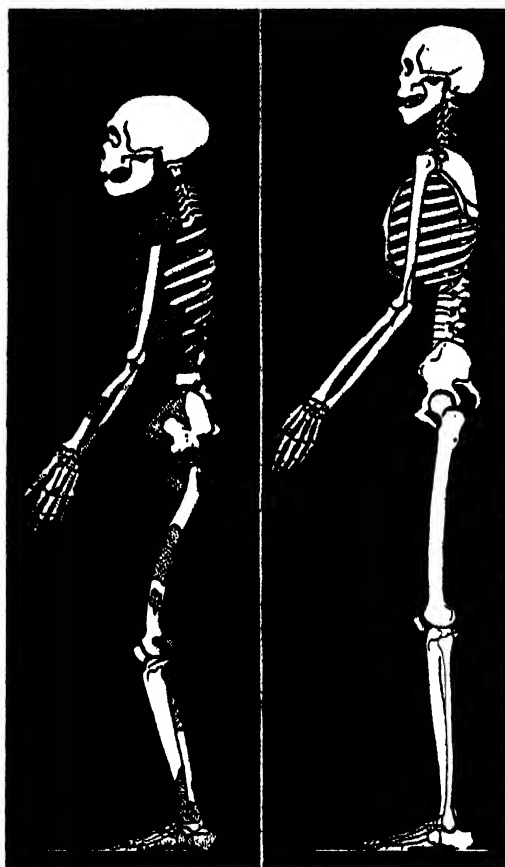
the fierce conflict in which he became involved he took exceptional pains to avoid any statement that he could not justify to his own complete satisfaction.

In trying to put ourselves in the position that Huxley was in in 1860, it must not be forgotten that at that time no human remains, either ancient or modern, had yet been found that did not belong to the same species as ours, that is, *Homo sapiens*. Moreover, Huxley admitted that in the absence of a jaw, which might afford decisive evidence, and in view of the conflict that was raging between those who denied that it was human, and the others who considered it merely a pathological specimen, he was constrained to take the middle course, and assume it to be simply a primitive member of our own species. Huxley clearly did not consider Neanderthal man as the ancestor of any modern race of men.

In 1886, however, an important discovery of two skulls of the same type was made at Spy in Belgium, and this event had far-reaching consequences. Not only did the discovery of the two heads (displaying the same remarkable features) destroy once for all the pathological theory put forward by Virchow, but the chinless jaws afforded evidence, the lack of which 26 years earlier had, on his own admission, swayed Huxley's judgment as to the extent of the gap that separated Neanderthal man from modern man.

WHAT was even more significant was the association of the two Belgian fossils with the remains of extinct animals (such as the mastodons, cave bears, and so on) and implements tens of thousands of years old, thus establishing the fact that these grotesque men were living in Europe at a time in comparison with which men of our own type seem to be quite modern.

In spite of these facts, however, and complete elimination both of the pathological and of the non-human theories of origin, scientific opinion did not become crystallized until the year 1900, when Professor Schwalbe of Strassburg made a detailed comparison of the form and measurements of the Neanderthal group of men, and proved to the satisfaction of most anatomists that the differences between Neanderthal man and modern man were so profound as to de-



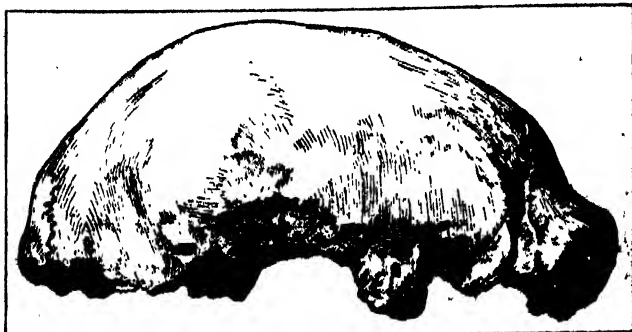
A STRIKING CONTRAST

Left: Skeleton of Neanderthaloid man of La Chapelle-aux-Saints. Right: An Australian; same scale

mand as an adequate expression of their magnitude the creation of a new species distinct from *sapiens*. This proposal had been made as long ago as 1864 by Professor William King of Galway, but he was unable to establish his claim in opposition to the cautious Huxley. Nor again was the distinction admitted when the Gibraltar skull, the first representative of Neanderthal man, which had been discovered as long ago as 1848, was brought to London in 1868 and described as a new species with the name *calificus*, by Falconer.

After Schwalbe's important demonstration of the distinctive traits of Neanderthal man, fresh evidence was forthcoming that not only established the justice of his claims, but also proved that this peculiar type of mankind had in certain respects become so highly specialized as to make it impossible to regard him as the ancestor of men of our own type.

FROM 1899 onwards for several years a vast number of fragments, mainly of jaws and teeth, were found near Krapina, in what is now known as Jugo-Slavia. It was shown by comparison of a large number of these teeth that they had become modified in a very peculiar and distinctive way, their pulp cavities becoming enormously enlarged, and the roots correspondingly reduced in length—so as



THE ORIGINAL NEANDERTHAL SKULL

Found in a cave in the Neanderthal Valley in Germany, in 1858.
Note the heavy eyebrow ridges and the low outline



Courtesy A. M. N. H.

THE SPY I SKULL

One of two later Neanderthal types found in a grotto near Spy, Belgium, in 1887

to form a type of tooth which differed from those of modern man almost as much as they differed from those of apes. This fact alone was sufficient to demonstrate that the ancestors of Neanderthal man must have already departed widely from the stem which gave rise to members of our own species. In other words, Neanderthal man himself could not by any possibility have been an ancestor of modern man.

In 1908 and the succeeding years, evidence of the utmost importance was obtained in the Dordogne Valley in France, which for most anatomists settled the issue once for all. The most complete skeletons of men of the Neanderthal type that had yet been found were obtained at La Chapelle-Aux-Saints and La Ferrassie, which came under the charge of Professor Boule of the Natural History Museum in Paris, who has written a series of illuminating reports and a book on fossil men.

NEANDERTHAL man is now revealed to us as a type differing profoundly from modern man—an uncouth type with enormous flattened head, very prominent eyebrow ridges and coarse face; the trunk is short and thick; the lower limbs are also short and thick-set. The broad and stooping shoulders lead by a curve to the forwardly projected head set on an abnormally thick neck. The hands are large and coarse and lack the delicate play between the thumb and fingers that is found in modern man. The nose is not sharply separated from the face, the two being merged into what in another animal would be called a snout. The large brain is singularly defective in the region of the forehead, and one is bound to draw the inference that Neanderthal man's hands and brain were incapable of performing those delicately skilled movements that are a distinctive prerogative of *Homo sapiens*, and the chief means whereby the latter has learned by experiment to interpret and under-

stand the world around him. By such means he acquired the high powers of discrimination that enabled him to replace Neanderthal man, whose brutal strength could not save him from extinction in competition with his more nimble-witted successors.

PROFESSOR BOULE'S investigations have shown that in every part of the body Neanderthal man revealed features that form a profound contrast to those of modern man. I have already referred to the peculiar features of the skull, face, and the chinless jaw. In the region of the thick neck the bones of the spine, instead of sloping downwards as they do in modern man, project horizontally backwards as they do in the chimpanzee and gorilla. In fact these parts of the spine differ so much from those of modern man that in many respects they were much nearer in form to those of the apes.

In the accompanying diagram I have attempted to indicate the contrast in form in the neck vertebrae (the sixth alone is shown) of Neanderthal man, in comparison with these of the gorilla and modern man, in order to suggest that, measured by the contrast between modern man and the ape, Neanderthal man differs profoundly from his successor. This is indicated also in the poise of the head, which (for the purposes of the diagram) was determined by the slope of the flow of the brain-case.

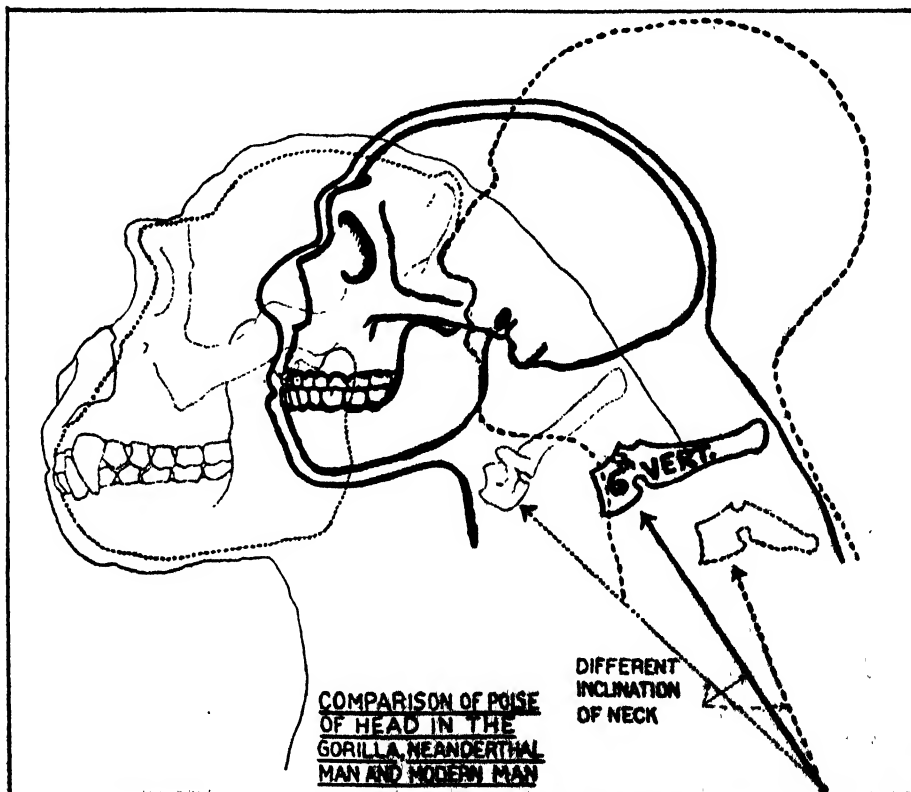
The distinctive features of the hands have been commented on previously.

In all the bones of the arm similar differences can be detected. The thigh bones, the leg bones, and especially the feet, reveal the most profound contrasts, which have been discussed and interpreted with great lucidity by Dr. Dudley J. Morton in *Natural History*, (1926, page 310) published by the American Museum of Natural History, New York. This gives a very clear explanation of the peculiar features of the foot of Neanderthal man, and its points of resemblance to the foot of the gorilla. In his book on "Fossil Man," Professor Boule has also explained the differences between the feet of Neanderthal and modern man.

The sum total of all of these researches has been to emphasize the consideration that in every part of the body Neanderthal man forms so profound a contrast to the type of modern man as to make it impossible to regard him as a possible ancestor.

LATER on in this article I shall explain how Dr. Morant has recently examined this problem by statistical methods, and has arrived at the conclusion that there is a profound hiatus between Neanderthal man, which exhibits a remarkable uniformity of type, and all the modern races of man, which can only be properly expressed by putting the two groups into different species.

In former years, from the time of Huxley up till modern times, when Professor Sollas of Oxford has revived



NEANDERTHAL MAN NOT OUR ANCESTOR

Neanderthal man differs profoundly from modern man. The author's diagram shows how different are the sixth vertebrae of the three types of primates. Study comparatively each detail.

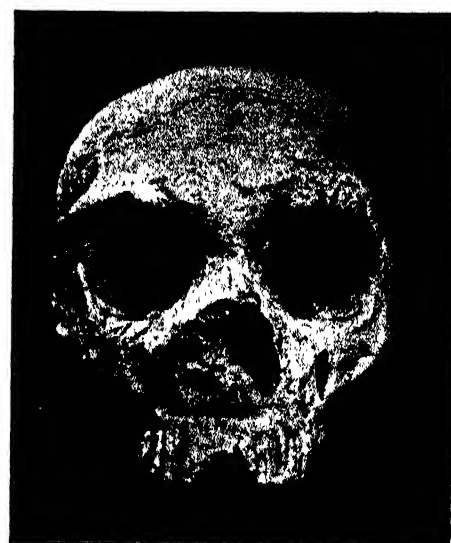
the discussion, many writers have been inclined to insist upon the likeness of Neanderthal man to the aboriginal Australian people; but there are many fundamental points of difference between them, and in spite of his primitive traits the aboriginal Australian conforms to the distinctive features of *Homo sapiens*. Dr. Morant confirms this by means of his statistical methods, and has arrived at the conclusion that although some modern races resemble Neanderthal man more closely than others, no race or group of races can be regarded as akin to those of the extinct fossil type. In other words, the statistical method has confirmed the opinion based upon the anatomical study, that Neanderthal man is widely separated from all living races of mankind, and cannot possibly have been an ancestor of any one of them.

MOST anatomists who have given serious attention to this matter agree in this conclusion, as will be evident to any reader who compares the accounts given in "Ancient Hunters," by Professor Sollas of Oxford, "Men of the Old Stone Age," by Professor Henry Fairfield Osborn of the American Museum of Natural History, "The Antiquity of Man," by Sir Arthur Keith, "Fossil Men," by Professor Boule and the many others who in recent years have investigated and written upon this subject. The justification for excluding Neanderthal man from

Smithsonian Institution, has just thrown a pebble of dissent. In the whole range of anthropological controversy no question seemed to have been more conclusively and definitely decided than the status of Neanderthal man. Hence, anthropologists were intrigued to know what new facts or new arguments Dr. Hrdlicka could adduce in justification of his attitude. He was delivering a lecture in London, to commemorate Huxley, who in 1864 expressed the opinion—

"that the Neanderthal skull exhibits the lowest type of human cranium at present known, so far as it presents certain pithecoïd characters in a more exaggerated form than any other; but that, inasmuch as a complete series of gradations can be found among recent human skulls, between it and the best developed forms, there is no ground for separating its possessor specifically, much less generically from *Homo sapiens*." (*Natural History Review*, page 443).

DR. HRDLICKA'S claim was no doubt an act of pious respect to the brilliant biologist in whose honor the lecture was given. But I doubt whether Huxley would have maintained this opinion if he had lived long enough to learn all the new facts that have come to light since the time when he last referred to Neanderthal man. For they have completely transformed the question at issue.



From Hrdlicka, Smithsonian Report, 1913

THE GIBRALTAR SKULL

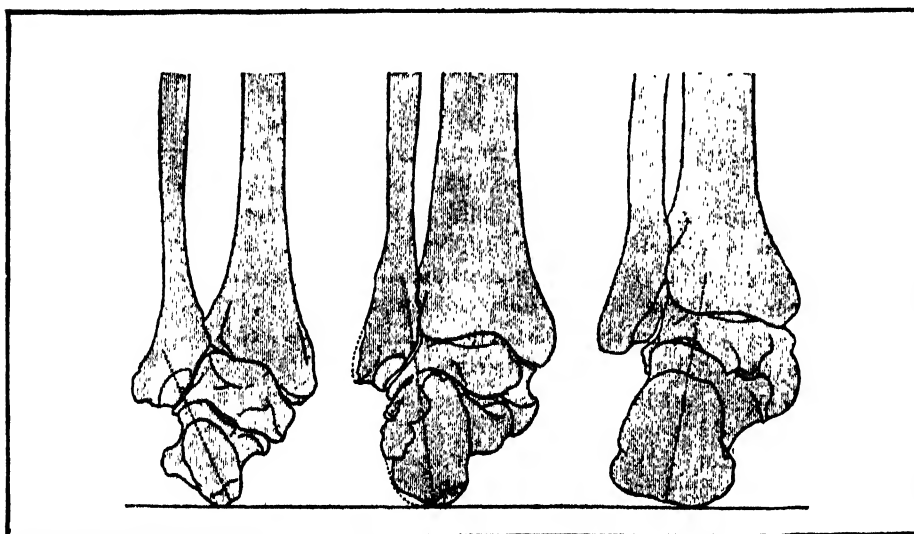
The first Neanderthaloid discovery (1848).
Its significance was missed at that early date

mains of a child of Neanderthal type.

Immediately after Dr. Hrdlicka's lecture Dr. G. M. Morant published a detailed statistical examination of the measurements of all the known skulls of Neanderthal type, in which he called attention to the remarkable uniformity of the series, the range of variation being very markedly less than that of modern man, thus effectively disposing of one of Dr. Hrdlicka's chief arguments. He showed that there is a very distinct gap between the relative measurements of the various diameters of the skull when the group of Neanderthal men was compared with the types that occur in modern man, and this hiatus he regarded as sufficiently great to establish a difference in species.

WHILE we all recognize that it is the business of scientists constantly to examine the evidence upon which their theories are based, and if in the light of new information they are found to be inadequate or not to conform to the known facts, to discard them ruthlessly, at the same time it is equally important that theories which provide an adequate explanation should not be abandoned until the new evidence appears, or the new arguments conform to these requirements and really discredit the theory.

My feeling is that the considerations submitted by Dr. Hrdlicka do not establish a case for reconsidering the generally admitted theory, and that none of the points raised by him in any way weaken the force of the overwhelming mass of evidence which compels us to regard Neanderthal man as a species, not only entirely different from every variety of living man, but as conforming to a type that is so highly specialized that it could not possibly have been ancestral to *Homo sapiens*.



Courtesy Natural History, after Boule

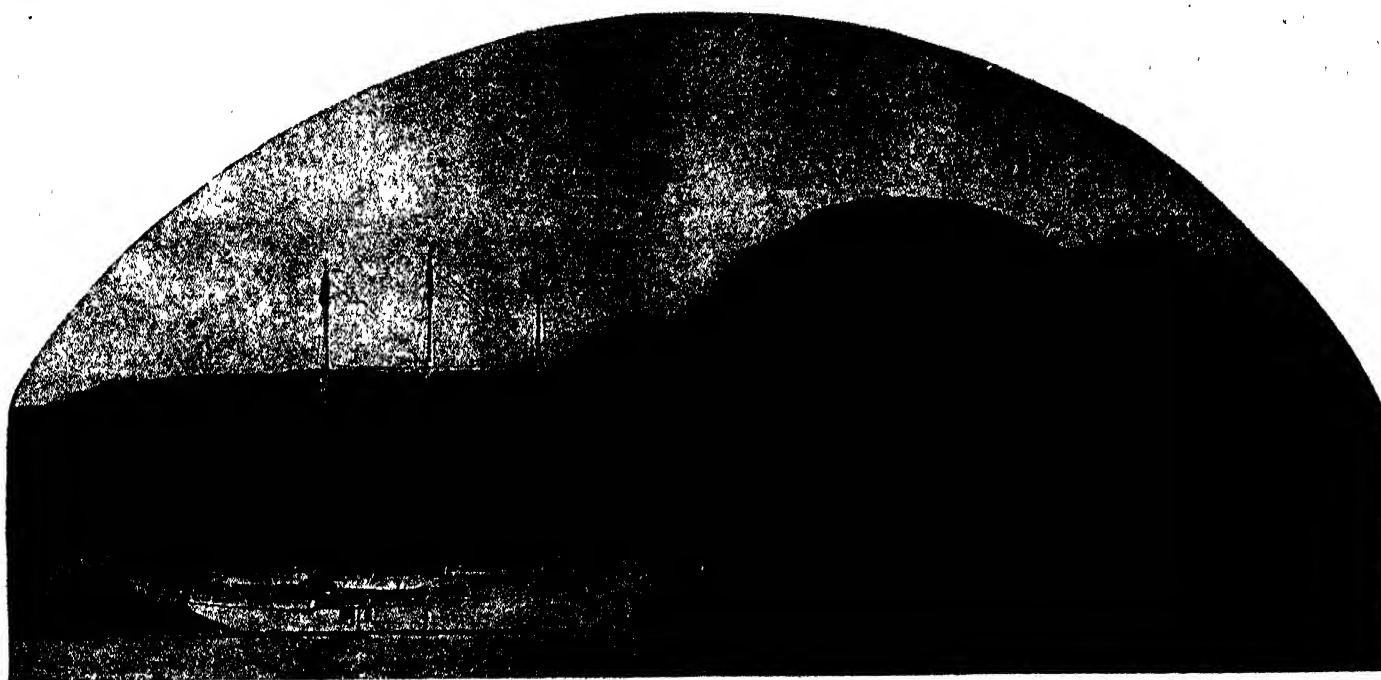
THE HEEL, FOR EXAMPLE, VARIES WIDELY

Left: Heel of chimpanzee; Center: heel of Neanderthal man of La Ferrassie; Right: Heel of modern man. The axes of the heels lie at widely different angles and the structure is not the same

our ancestry and putting him into a species distinct from all the living races of men, has now for more than a quarter of a century been admitted by almost everyone competent to express an opinion upon the subject.

Into this stream of settled opinion, placed after so many years of storm, my friend Dr. Ales Hrdlicka of the

At the time when Dr. Hrdlicka arrived in London to deliver his Huxley lecture, two events happened that had a very immediate bearing upon the controversy he was re-opening. At the Royal Anthropological Institute a week before his lecture, Miss Dorothy Garrod gave full account of her discovery (in 1926) of the fossilized re-



THE YACHT "FISHERMAN" IN NEW ZEALAND WATERS

In this yacht, Mr. Grey, the author of the accompanying article, and his party visit remote corners of the world, exploring the depths of the oceans with rod and line. Scorning the use of "mass production" methods of fishing, their search for unusual fish results in great sport.

Big Game Fishing in New Zealand Seas*

*The Sportsman and the Scientist Work Hand in Hand
to Provide Specimens for Museums*

By ZANE GREY

Patron of the American Museum of Natural History

MY first fishing trip to New Zealand (1926) was in the nature of a pioneer expedition. The game was new there, and methods and tackle crude in the extreme. We anticipated criticism and opposition, and we certainly got it in plenty. The English anglers were slow even to consider American tackle and methods, let alone to adopt them.

The results of this trip, however, justified our venture and rewarded us beyond measure, and we had the satisfaction of winning a number of New Zealand anglers to our methods. We secured five world records, two of which were phenomenal. Here follows a partial summary of our catch; and the large number we think is justified owing to the desire of the New Zealand Government that we catch and identify and photograph fish, to attract the attention of the scientific and angling world to these new waters.

Captain Mitchell took two black marlin (*Makaira marlina*) of 685 and 976 pounds (the latter the world's

record); 21 striped marlin (*Marlina mitsukurii*) ranging from 192 to 350 pounds and averaging 259½ pounds; 3 yellowtail (*Seriola dorsalis*) of 70, 75, and 80 pounds, averaging 75 pounds; and 6 mako (*Isurus* sp.) varying from 180 pounds (two specimens) to 299 and averaging 236 pounds.

I TOOK, among other fishes, one broadbill swordfish of 400 pounds—the first *Xiphias gladius* ever caught with rod and reel in New Zealand waters; one black marlin of 704 pounds; 41 striped marlin, ranging from 168 (the only specimen below 200 pounds in weight) to 450 pounds (the world's record) and averaging 268½ pounds; 17 mako ranging from 56 pounds (the next smallest being 115) to 300 and averaging 190 pounds. Among others of my catches was a yellowtail of 111 pounds—another world's record.

This extraordinary fishing (surely never surpassed in the angling history of the world) explains why we (Captain Mitchell, my brother R. C. Grey, my son Romer, and I) were all so desirous of making a second trip in

1927. We did make this trip, as the following account tells in part, but owing to 42 days of storm we did not equal our first experience.

The strangest and biggest fish we captured on our second expedition to New Zealand waters was a thresher shark (*Alopias vulpes*) of 640 pounds, incidentally the largest ever taken on rod and reel. But I cannot claim the record because, although I got the strike and hooked the fish, I mistook it for a common shark and handed the rod over to my son Romer.

We were fishing off Stevenson's Island, outside of Whangaroa, where some miles off there is a submerged reef of large area. In 1926 Captain Mitchell and I fished this location and also the Cavalli Islands, where I was the first to land a swordfish. Both places have since become popular with anglers. These are indeed magnificent fishing waters. During the summer great schools of *kamohi* and *crevalle* feed there on the surface at certain hours of the day. While feeding, one of these schools will make a rushing noise like the tumbling of a brook over

*Published by permission of Mr. Grey and *Natural History*.

stones. At such time swordfish, *mako* and other sharks abound.

The thresher shark is one of the rare fish of the seas. At Catalina I have had several follow a trolled bait. They stuck their long tails out of the water and struck at the bait with them. Of all strange weapons that have evolved upon fishes of the seas, I think the tail of the thresher is the strangest. If his body is nine feet long, his tail will be ten. When swimming, he can look backward and upward at the tip of this tail and strike very accurately with it, since his eyes are situated almost on the top of his head. He makes one think of a prehistoric monster that has survived to the present.

THREE threshers have been caught at Catalina in twelve years—all small ones, around 300 pounds each. Each one was hooked through the tail. They had snagged themselves on the hook while striking at the bait. In New Zealand threshers are caught pretty often, and run fairly big. Often they leap like greyhounds of the sea, a most unusual and wonderful spectacle. And they are hard-fighting fish.

This 640-pound one that I ran on to in New Zealand, fooled me in the strike. He had not shown on the surface and his bite was nothing much to speak of. But he felt heavy and slow, like a *reremai*—a ground or sand shark—so I gave the rod to my boy with the remark: "Here, Romer, see how quickly you can lick this fish."

Now Romer is a husky lad and has had some luck with big fish. As all boys do, he brags a little. Sometimes seeing me or Captain Mitchell or R. C.* in difficulties with a big fish he is

*My brother R. C. Grey.



A "MAKO" SHARK

The author, standing beside a 278-pound mako shark which was caught and landed with the rod and line which he holds. Fish of this kind put up a terrific battle

prone to remark: "Say, it takes you a long time on that fish. Pull his head off. I could!"

However, Romer met retribution in this thresher. For the first hour he could do nothing with the fish. Meanwhile R. C. came up and made remarks. "Why don't you pull him up? You're weak in the back, boy. We can't hang around all afternoon."

Then Captain Mitchell ran up in his boat: "Hey, Romer, what're you on? We're mighty curious to see if you can lick him." And I said: "Son, for a

boy who's a sprinter and who aims for football, you are sure slow as an angler."

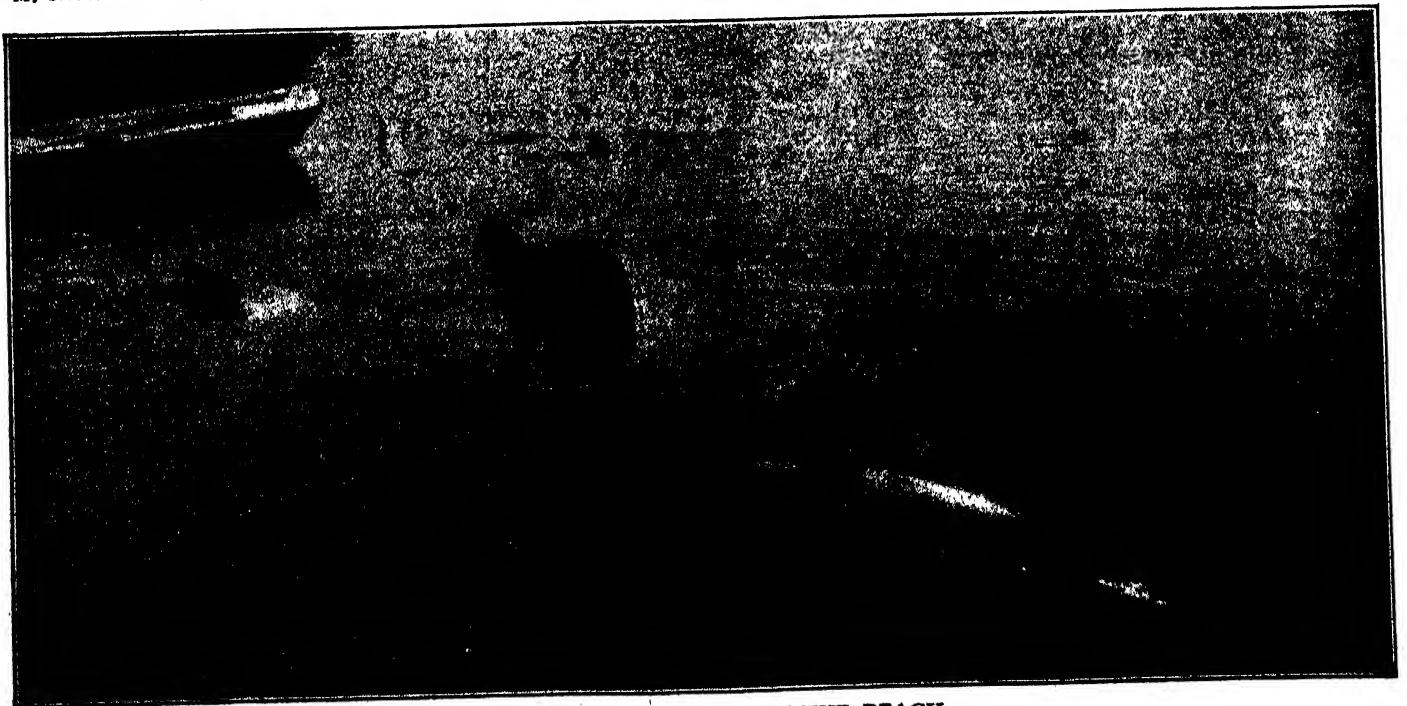
Altogether—for the boatmen and his pal, Johnny Shields, got after him too—we made him see red. It really was a mean trick. But Romer himself sometimes plays mean tricks. However, he worked on that fish as he had never worked before on anything—and he has fought some pretty good battles.

At the end of two hours he had the thresher stopped, and in another hour and a half he had him whipped. Really he gave a magnificent exhibition. He blistered his hands, lamed his back, and ruined my rod, but he whipped the thresher.

WHEN the great fish came up so we could see him, I certainly sustained a shock—and I have seen a great many remarkable sea-creatures come up out of the deeps. He was a huge, grotesque, frightful, and terrible fish to gaze upon. All my fishing years I had longed to catch a great thresher. Here I had struck one—a record—and had turned the rod over to my son! The joke was on me.

The thresher must be classed as a game fish. He fights deep most of the time and is exceedingly stubborn. Comparing him with the *mako*, he is pound for pound a harder fish to whip.

The *mako*, however, is the aristocrat of all sharks. It is really unfitting to call him a shark at all. I seldom use the word with regard to him. And after he attains some weight—say over 400 pounds—he is indeed a magnificent sporting fish. His leaps are prodigious, inconceivably high above the water. The ease and grace of this leap is indescribable. It must be seen. He



A THRESHER SHARK ON THE BEACH

This shark, classed by the author as a game fish, has the peculiar feature of an unusually long tail. If the shark's body is nine feet long, the tail will be ten feet long. It was one of these sharks that Mr. Grey's son battled for six and a half hours, and conquered



R. C. GREY AND SWORDFISH

The author's brother poses with a 386-pound striped marlin swordfish. This fish comes next in size to the author's record catch of a 450 pounder, landed in 1926

comes out slick, glides up, turns a somersault, and goes down heard first, like a diving gull, almost without a splash. Then instantly he is out again. Seldom does a *mako* leap once only. I have had one go up six times—a most thrilling sight. His third leap is always the highest.

The *mako* seems to be known only in New Zealand and Japanese waters. He attains huge size, up to 2000 pounds. Captain Mitchell hooked one in 1926 that leaped twice—the first time scaring us nearly to death, and the second giving us time to judge his weight fairly at around 1200 pounds. Needless to state here, that *mako* is still roaming the sea. Some day, though, we will catch one that large or even larger.

We caught two black marlin in New Zealand waters in 1927, both small fish—340 and 380 pounds. Quite a comedown from our 1926 fish of 704 and 976 pounds. However, the capture of any black marlin is an event to be proud of, and 1927 was a bad season because of rough waters. Captain Mitchell's fish, the larger of the two,

leaped out of the water as the captain was winding in the bait, and nearly landed in the boat. The fish was after that bait and he got it. Then he gave a grand exhibition of fighting on the surface. My black marlin, 340 pounds, charged my "teasers" and bait, and certainly committed suicide.

It is my opinion that fishes of this species do not like rough water, as the striped marlin do. During three months, I had hold of only one, beside that which I caught. I saw this fish heaving up behind my bait and he sure was big. He took it and I struck at him, but—alas!

We saw a very large black marlin, surely a 1000-pounder, riding the swells. It was in shore near the en-

sure he would bite. He did not. Then I did have a fit.

My brother, R. C., struck a striped marlin off the Cavallis which gave perhaps the greatest surface exhibition I ever saw. This fish was one of the long slim ones, as marlins go, but he was so swift in his leaps that we could not train the cameras on him, and so strong that R. C. could just barely stay with him by running the launch full speed.

IT was bright sunlight, with just a ripple on the dark blue sea. The marlin blazed in the air, green on the back, striped across his silver-white sides. He cracked the water like pistol shots; he made every kind of a splash, from a thin cutting of spray to a great, angry boiling maelstrom. The beauty and wonder of such spectacular acrobatics must be seen to be believed and appreciated. Especially must the magnificent fury or fright of this tiger-species be seen. It cannot be adequately described. This marlin weighed 386 pounds, and comes next to my record (450) of 1926.



AUTHOR AND SON

The 640-pound thresher shark is shown. Note the extreme length of its strong tail

trance to the Bay of Islands, on the way to my yacht at the close of day when we had no good bait. I put on the only one there was—a *kahawai* stiff as a poker.

We followed this marlin—all three boats—and the closer we got to him as he rolled up in the swells the louder we yelled. If I had known then that we were going to see swordfish in the South Seas twice as big as this one, I might have saved my breath. But there are lots of things we do not know until they happen. Anyway when I got my bait in front of this marlin and he sheered off after it, I nearly had a fit. He refused to take it. We followed, and made careful approach to drag the bait again before him. He came to it and swam clear round it. We were



CAPTAIN L. D. MITCHELL

He is shown here with a 976-pound black marlin swordfish. This is the largest one caught during the 1928 season, and exceeds any caught on the last expedition

Giving Scales a Variety of Jobs

Balance Scales Now Used for Many Purposes Besides Simple Weighing

IN written history, the first reference to weighing is given in the narrative of Abraham's dealing with the sons of Heth. He paid them 400 shekels for a burial place, weighing out the money with a balance. This ancient medium of exchange was not a coin in the sense we know it, but was the amount of silver equal to the shekel weight—about one ounce avoirdupois.

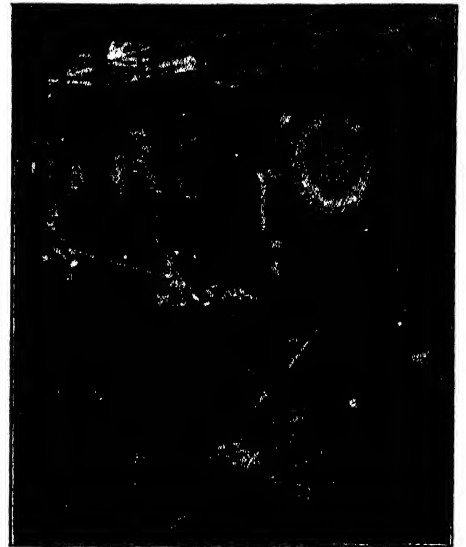
In Act 51 of King Henry III, dated 1266, is written: . . . an English penny called a sterling, round, and without any clipping, shall weigh 32 wheat grains in the midst of the ear."

Thus this method of counting monetary value by weight survived the vicissitudes of many years despite the introduction of the coinage system. Today, scales are being used to count, not monetary value, but the number of small parts, such as screws or bolts, in a mass; the number of yards in a bolt of cloth; or the number of gallons of liquid in a container.

Knowing the exact weight of one unit of the mass or volume to be counted or measured, it is an easy matter to weigh the whole on an accurate scale and, by simple division, find the quantity of the mass in whatever units may be desired.

Suppose, for example, a steel hammer, a yard of woolen cloth, and a pint of liquid each weighs one pound. We weigh some of each and find that each totals 20 pounds. We know then that we have 20 hammers, 20 yards of cloth, and 20 pints of the liquid.

TO obviate more laborious methods, this principle is being used in industry to count bolts, nuts, machine parts, and many other products, to measure spring tension, horsepower, liquid volume, and for sorting, checking, and testing in a great variety of ways. The automatic scale, employ-



COUNTING A SHOVELFUL

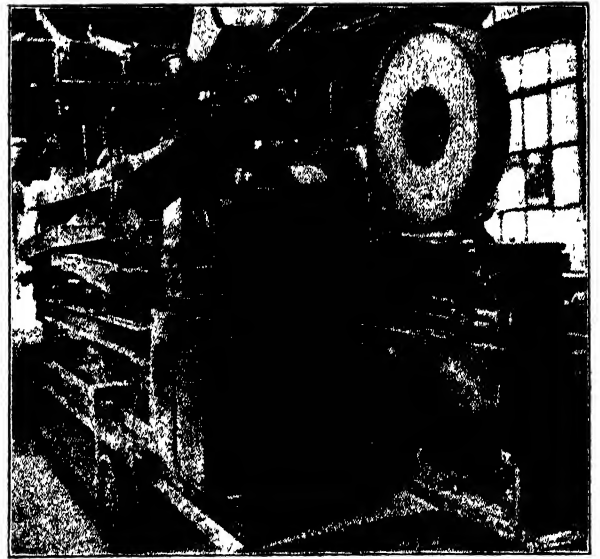
Weights in the pan on tare beam lever, indicate, by ratio, the number of hinges weighed

ing no springs but depending on balance rather than distortion, is commonly used today to hold down a great number and variety of odd jobs.



SORTING EQUAL-WEIGHT SETS

Connecting rods are here weighed and placed in sets to minimize grinding work



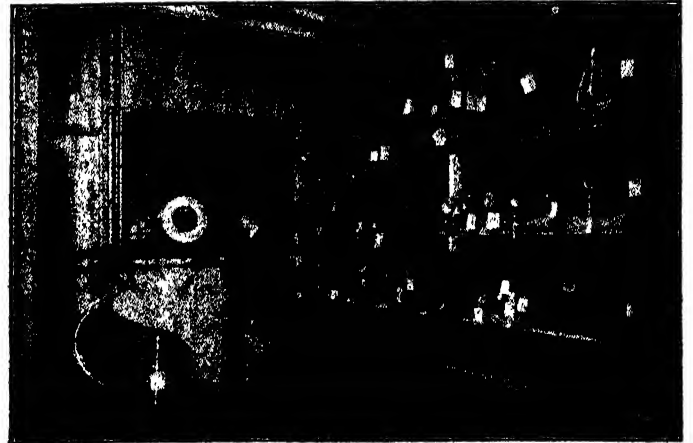
BATCH WEIGHING IN GLASS PLANT

This hopper scale passes under hoppers; material is drawn from each; weighed; mixed; and then emptied



SCALE FOR "WEIGHING" HORSEPOWER

Used with Sprague dynamometer, this scale may be designed to show torque in pounds, or horsepower directly, of an airplane motor



YARDAGE SCALE FOR HEAVY FABRICS

A perpetual, accurate inventory of valuable upholstery fabrics may be maintained with this scale which shows number of yards in the roll

What Becomes of the Starlight?

If Space Is Infinite and Finally Empty, the Energy Radiated From the Stars Must Go On Forever; But if Space is "Curved"—What Then?

By HENRY NORRIS RUSSELL, Ph.D.

*Chairman of the Department of Astronomy and Director of the Observatory, Princeton University
Research Associate of the Mt. Wilson Observatory of the Carnegie Institution of Washington*

THE engineer is always keenly alert to secure the highest possible efficiency in his machinery. Whether he seeks to transform electric energy into light in a lamp, or power in a motor, or mechanical into electrical energy in a dynamo, or to turn heat into mechanical energy in a steam or in an internal combustion engine, he desires always to reduce the wastage incidental to the transformation.

In some cases such as the electric motor these losses are small, but in heat engines of whatever sort they are inevitably large. From the very nature of things as expressed in the famous "Second Law" of thermodynamics, it follows that when we take heat into our engine from a source of high temperature we can turn only a part of it into mechanical work and must dump the rest, still in the form of heat, into some region of lower temperature—for example, into the water which cools the condensers of a power plant. The energy comes to us at first in the form of rapid chaotic motions of the molecules. We can turn part of it back into orderly motion of our machinery, but not all—the rest still remains attached to molecular motion and must remain thus as long as we have no way of stopping this motion entirely; that is, working with the cold side of an engine at the unattainable absolute zero.

YET even our power engines have an efficiency of 10 percent. How is it with those vaster engines which nature shows us in action—the stars?

The stars may be regarded as heat engines in the physicist's sense of the word—on an enormous scale. They are drawing upon internal energy of some sort, transforming it into heat and radiating it away into space. What becomes of the heat? Is any of it "used" and if so, what fraction?

If we are to count as energy "used," only that fraction which falls on other known bodies, the efficiency of a star—and in particular of the Sun—is almost incredibly small. Of the whole flux of radiation from the Sun only one part

in 230 millions is caught by all the planets together. The rest goes out into interstellar space. The fraction intercepted by the other stars must be excessively minute. Far more is taken up by the dark nebulae—on account of their enormous size—than by all other known bodies together. But even these cover but a moderate part of the heavens, and most of the radiation passes out beyond them into the unknown.

Moreover, the radiation which is intercepted, for example, by the

We can be quite sure that not one part in 10,000 millions of the Sun's heat is permanently stored as energy in any known body. If to make such a transfer of energy from place to place were the Sun's business, we would conclude that its efficiency was less than 0.0000000001. But we have no valid reason for making this assumption. Whether we can say anything at all about the efficiency of the stars depends upon what we may conclude about the fate of the radiation which escapes far into the depths of space millions of light years from its source. No certain answer to the question can be given in the present state of human knowledge, but several possible answers present themselves for our consideration.

FIRST, it may be that space is infinite and—outside the region occupied by the Milky Way, the star clusters and the nebulae—practically free from obstructing matter of any sort. In this case the escaping radiation will simply go on forever, speeding out ever more widely and growing correspondingly feebler. If, as most astrophysicists now believe, the radiation of the stars is maintained by a gradual transformation of their substance (mass) into energy (heat), after the manner imagined by Einstein, it might be conceived that all matter might aggregate into stars and that, in the course of sufficient time, the stars would wear themselves away and disappear. The energy derived from the transformation of their substance would leave

the once star-sown portion of space and become lost in its infinite depths, and the material universe would have vanished into the void.

There is nothing known to science which is hostile to this prophecy—except that the concentration of all matter to form stars appears improbable. The prospect which it unveils is, however, aesthetically disagreeable to most people—just why, the writer has never been fully able to understand. But, fortunately, other forecasts are possible.



Courtesy of the Carnegie Institution

THE FAMOUS BRUCE TELESCOPE

*Camera with which the photographs for the remarkable new Barnard, Milky Way photographic atlas were made.
The main lens is ten-inch doublet*

planets, is not permanently trapped. A very small part of it may be stored by chemical change like that which had gone to make the earth's coal beds, but almost the whole goes to heat the body on which it falls and to raise it to such a temperature that it radiates heat away on its own account as fast as it receives it; and again the flying energy, after a transitory delay, is

"On the old road from star to star
A wanderer and a vagabond."

It may be, for example, that space is not infinite but returns upon itself in some fashion. If we come down to the simple case of space of two dimensions—a surface devoid of thickness—we can see at once how this can happen; as in the obvious case of a sphere, and in many other ways represented by other less regular closed surfaces. We cannot make any picture in our minds of how space with its three dimensions may be similarly re-entrant; but the mathematician will tell us that this is because our imagination is unequal to the task of getting outside the space in which we live and move, and viewing it as a whole as we view the surface of a ball. By his more powerful tools of analysis he can show that the idea of space returning into itself is logically consistent, with nothing at all absurd about it.

WE cannot, indeed, determine whether the actual space in which the stars are situated is "flat" (that is, infinite) or "curved" (that is, re-entrant). All that we can say is that if it is "curved" the portion which extends out to the remotest visible nebulae must be but a very small fraction of its whole extent, so that its "curvature" would no more need to be considered than the curvature in the ordinary sense of the earth's surface (which we call sea level) needs to be considered in crossing a Hudson River ferry.

If space is "curved" the escaping

radiation must alternately return and sweep about it forever from one part to another. We can be sure that it does not return upon its path so precisely as to be focused, so to speak, once more upon the point of its origin, for in that case we should see light shining from places where stars once were and are no longer (since all the stars are moving). But if the return is not so precisely upon the same track it is quite possible that we should simply have scattered radiation flying about in all directions through space.

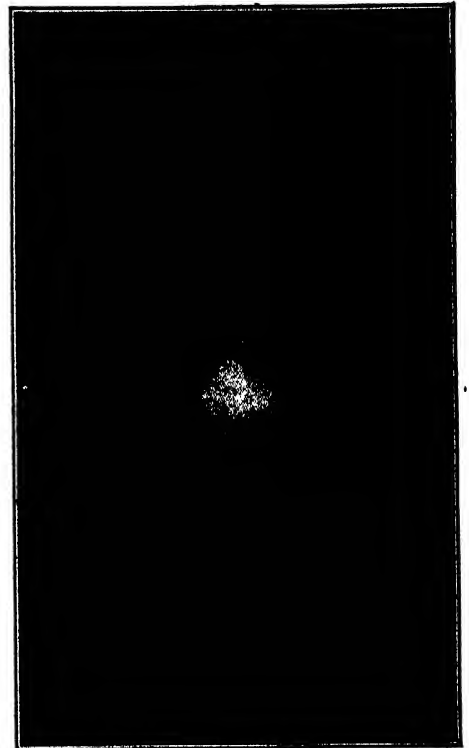
Such diffuse radiation would probably be very feeble. Jeans—basing his calculations upon best available data—finds that if all the matter contained within the region of the spiral nebulae were converted into radiation, and this radiation condemned to wander endlessly about this same region, the average intensity of the radiation would be about that of ordinary moonlight. That is, about 500 times as great as the light of the stars on a clear moonless night.

We see, then, that if space were everywhere filled with stars and nebulae as densely as it is in the region that we can observe, and if all these except the solar system were turned into radiation, we would have a far brighter sky than we now see. But if the whole extent of space were a few hundred times greater than that of the nebulae-filled portion of it, the whole material universe might disappear and leave no trace except a feeble diffused illumination like our present starlight.

BUT is this the end? May not the process of conversion of matter into energy be reversible so that the diffuse energy of radiation ultimately becomes reconcentrated into atoms, starting a new cycle of change; and so on forever?

No one can answer this question. We know of no process by which this change might be effected; and when it comes to details it is very hard even to imagine any. In the diffused state of radiation contemplated by Dr. Jeans, the amount of energy which is required to make a single hydrogen atom would be spread through some 400 cubic feet of volume. How all this could be concentrated into the minute region which the newly formed atom would occupy, is beyond our imagination to conceive.

The riddle becomes still more difficult when it is realized that the radiant energy is not stationary, but is flying about in all directions with the velocity of light. Moreover, unless the radiation were of even shorter wavelength than the most penetrating of the cosmic rays which Dr. Millikan has so brilliantly investigated, a single quantum or natural unit of energy of this radiation, if turned back into matter, would not make nearly enough to



Courtesy of Mt. Wilson Observatory

ANOTHER UNIVERSE

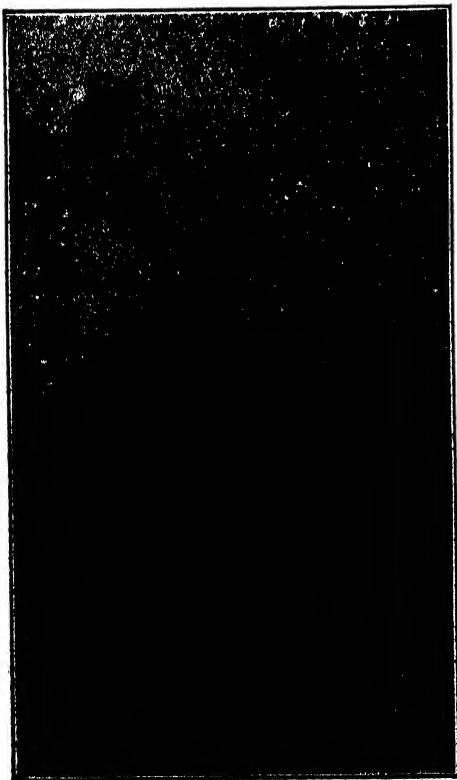
Beyond the spiral nebulae (other universes) what? Emptiness; or is space "curved" and finite? Here is a case where our common sense tells us one thing and our reasoning suggests the opposite. Time may tell

form an atom. We would then have to suppose that dozens or hundreds of quanta of radiation coming from different origins, in some way were simultaneously combined to form our new-born atom. To picture such an event certainly staggers the imagination. Dr. Millikan's bold suggestion that the production of the cosmic rays results in some cases from the union of 28 hydrogen atoms to form a silicon atom is comparatively tame, although it is not easy to see how the 28 electrons and 28 protons can all get to the same place at the same time or nearly enough so to form a heavy atom.

BUT it would not be justifiable to say that because we cannot imagine how a thing could happen, it is impossible. It may be that atoms are reformed from radiation somewhere in space, but we have not the least evidence they can be so formed—much less that they are.

Our speculative thought has wandered far beyond the bounds of experience and the knowledge based on it, and the only sound intellectual position on this question is agnostic. We simply do not know.

Q Once more the famous non-magnetic ship Carnegie is sailing the seven seas in search of fact. What fact—merely the state of the earth's magnetism? Far from it. The many things the scientific staff is doing on the long voyage will be explained authentically in a future article.



From the new Barnard Atlas, Courtesy Carnegie Institution

STARS AND COSMIC DUST

These lie within our own universe, yet there are a billion of them within photographic range. We know of some hundreds of thousands of other universes, many of them doubtless as large or larger than our own universes

Farming Under Paper

Crops Will Be Bigger, Earlier, More Numerous and Produced With Less Labor When We Grow Them By the Method Now Used With Tremendous Success to Raise Pineapples In Hawaii

By MILTON WRIGHT

THE pineapple growers of Hawaii last year paid 500,000 dollars for paper under which to grow pineapples. You can buy a lot of paper for a half million dollars, but then a lot of pineapples are grown in Hawaii and 90 percent of the

dous task to keep down the weeds which sapped the life of his crop. Year after year he had been heaping crop refuse between the rows—mulching is the term farmers use—for the double purpose of blanketing the weeds and retarding the evaporation of moisture. There was an objection to this, however. The mulch would decompose after a short time and, becoming a part of the soil, would actually encourage the growth of weeds.

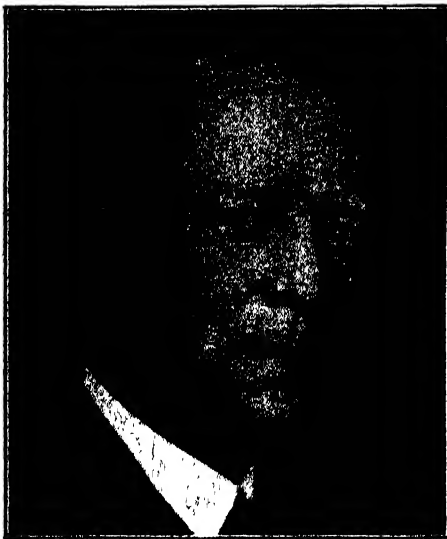
If only Eckart could find a mulch that would control the weeds permanently, he would be making a tremendous stride forward. At last he hit upon a tough kind of paper. He impregnated it with asphalt and laid it on the ground over the fresh cut stalks and seed cane. To hold the paper down he turned the soil over the edges. The sharp shoots of the young plants easily stabbed their way through the mulch of paper, but the weeds were effectively smothered.

The idea grew. That a paper mulch meant farming without weeds was readily understood, but other advantages began to be realized. It meant bigger and earlier crops with less labor. The use of black paper, it was found, raised the temperature of the soil, for the black surface of the paper absorbed the rays from the sun. Also the soil did not cool so quickly. The activity of bacteria was increased with the rise in the temperature of the covered soil.

Furthermore, the moisture remained in the ground until it was absorbed by the plant roots instead of being wasted quickly by evaporation. Then, too, the paper preserved the original cultivation of the soil throughout the growing period. You tilled the earth once at the beginning of the season and no more, save for turning the earth over from time to time in the rows by machine.

THERE were many reasons why plants should benefit greatly from the heightened temperature of the soil. Bacteria break down organic compounds and convert them into nitrates and other soluble forms to nourish the plants. These micro-organisms are extremely sensitive to temperature conditions. When the temperature drops below 41 degrees, Fahrenheit, they cease to develop nitric acid. At 98 degrees they are at the height of their vigor. At 113 degrees their activity drops back again to what it was at 59 degrees. It is important, therefore, that the soil temperature be right, and any means which keeps the soil temperature at a proper level is worth while.

Another factor in plant growth stimulated by soil temperature is osmotic pressure. Osmosis is that process by which the moisture is carried from the soil into the roots and through the stems and leaves; upon it all plant development depends. The



THE ORIGINAL PAPER FARMER

What helps sugar cane in Hawaii should help other crops elsewhere, he reasoned

crop is grown under the paper. Of course, the growers get back the money they spend for paper—they raise 30 percent more pineapples than they otherwise would—and there is a tremendous saving in labor.

BUT the Hawaiian pineapple crop is only the beginning. Without any great stretch of the imagination we can see the day—not so very far off—when nearly all our plants—potatoes, corn, tomatoes, spinach, cotton and what not will be grown under paper.

For four years the Department of Agriculture has been carrying on a number of experiments with it and their comparative tests have demonstrated beyond dispute the value of paper to stimulate plant growth. With every crop save one—peanuts—the experiments were an unqualified success.

To understand the use of paper in agriculture, suppose we go back to its origin. On a sugar plantation near Honolulu, before the World War, Charles F. Eckart found it a stupen-



A DIVERSIFIED CROP TEST

Before the tiny shoots of plants, grown by the age-old method, have done much more than peep above the surface, the mulch-paper protected plants are well on their way toward maturity

degree of osmotic pressure and the rate of its action depends upon the temperature—the higher the temperature the greater the osmotic pressure. Tobacco plants and pumpkins have been known to wilt at night, even when there was abundant moisture in the soil, as soon as the soil temperature fell much below 55 degrees.

Some soils, of course, absorb much more heat than others, the temperature being largely dependent upon the color. Dark earth absorbs more heat than light-colored earth, and soils of any color at night or in cloudy weather have a tendency to cool off until they reach the temperature of the surrounding air. Usually dark soils remain slightly warmer than light soils at night, but this difference is much more pronounced between soils which are covered with mulch paper and those which are not.

WHERE you have the same moisture content in a light colored soil and a dark one, the dark colored soil shows the greatest gain when you use dark colored mulch paper. Black soil absorbs the most heat, brown next, red next, yellow next, and gray the least. When mulch paper is used, the heat-absorbing capacity of all the various colored soils tends to be equalized. The soil which ordinarily is a good heat absorber becomes a better heat retainer, and the soil which has the least heat retaining capacity is raised to the capacity of the greatest.

With one unused to the use of mulch paper, the thought is likely to occur that rains would be prevented from reaching the soil under the paper. The fact of the matter is that the water reaches the soil through the openings where the plantings are made or between the edges of the paper and seeping downwards or sideways, due to gravity and capillary action, is stored up under the blanketing effect of mulch paper.

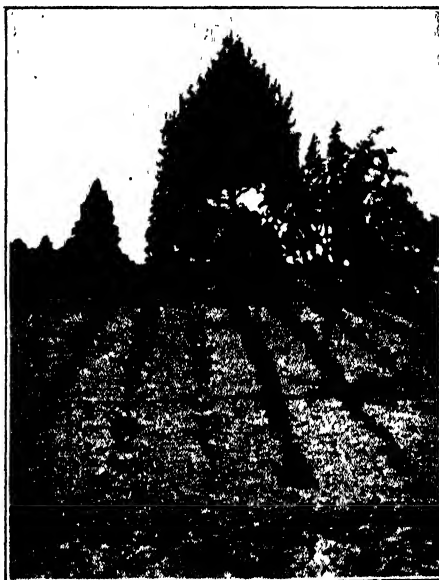
With the theory of mulch paper being so sound and full of promise, to say



THESE CUCUMBERS ARE FOUR WEEKS OLD

The plants at the left were grown under mulch paper. Their growth is not only great but uniform. The plants at the right were given the usual care accorded to cultivated vines. Note the difference

nothing of the remarkable results achieved in the Hawaiian Islands, the Department of Agriculture and others began experiments in this country in a



THEY OVERCOME PERSPECTIVE

The plants in the background actually loom up larger than the unpapered crops

variety of climates and soils and with a variety of crops. Side by side plantings were made, one set under mulch paper and one set uncovered. With sweet corn, beets, sweet potatoes, white potatoes, turnips, tomatoes, spinach, cotton—with every crop which was tried, save one, the results were phenomenal. Here where the paper was used in the middle of the growing season you would find nothing but splendid, luxuriant growths. There, where there was no paper, you would see the weaker brothers and sisters of those same plants, their growth lagging far behind.

THE single exception was peanuts. Instead of increasing the yield, mulch paper actually decreased it by 46 percent. The explanation lay in the fact that the mulch paper prevented the natural pegging of the plants.

Here are the results from trials with and without mulch paper at the government's experimental farms at Arlington, Virginia. The percentages show the increased yield of the mulched areas.

White potatoes.....	73 percent
Cotton.....	91 percent
Sweet potatoes . . .	122 percent
Celery.....	123 percent
Peppers.....	146 percent
Eggplant.....	150 percent
Green beans.....	153 percent
Beets.....	409 percent
Carrots.....	507 percent
Cucumbers.....	512 percent
Sweet corn.....	691 percent

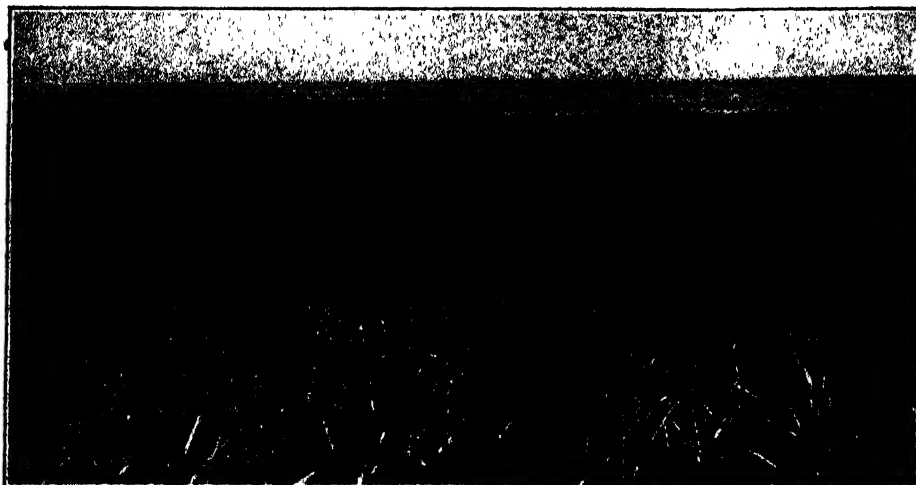
One thing made clear by the experiments is that not only are crops more abundant, but they are earlier. In many cases this affords the possibility of an additional planting before the growing season is ended.

Applying mulch paper to a crop area is simplicity itself. The paper comes in rolls—150 or 300 yards long and in widths of 18 and 36 inches. The farmer lays the roll down across one end of a



RESULTS IN THE LABORATORY

The soil on the unmulched onion sets at the left formed a hard cake through which the shoots had to force their way. Under the paper the soil remains soft and retains a lot of moisture



WHERE MULCH PAPER MAKES ITS MARK

Observe what looks like parallel lines running across this field of pineapples. Each line is a row of plants not protected by special mulch paper. They did not grow as high as the others

row of cultivated soil and unrolls it to the other end over or between the beds. The paper is thus in direct surface contact with the beds. Where drill crops are to be planted a strip of two inches or less is left between successive strips. The paper is anchored to the ground with stones laid on, with staples driven through, or simply with dirt turned over the edges. In broad fields, where the strips are some distance apart and the wind has a chance to lift the edges, it generally is best to turn the edges of the paper down into shallow trenches and cover the margin with soil.

AN easy way to lay the paper in general field work is to fit an adjustable handle into the ends of the roll. One man takes the handle and walks away from the paper, rolling it out, while another man on each side turns enough dirt over the edges with a small hoe to hold it down from the wind until small plows can throw soil over the edges to hold the paper in place permanently. In Hawaii, where thousands of miles of paper are laid each year, specially designed paper-laying machines are drawn by mules or tractors. With a single operation such a machine prepares the bed, lays the paper and covers the edges.

Planting is done by either of two methods—through the paper or between strips of paper. Where you have such crops as tomatoes, eggplant, peppers, pineapples or field corn which require rather wide intervals, the best way is to plant in regularly spaced openings made through the paper. The opening may be made in any one of several ways. With pineapples, for example, the usual practice is to stab a hole through the paper and into the soil with a rounded stick or dibble. The pineapple slip is then placed in the plant bed through the opening. Sun-grown Sumatra tobacco also has been grown successfully when the planting has been done by this method, the in-

crease in yield amounting to as much as 71 percent over the old method.

With tomatoes and other less hardy plants, it is advisable that the openings be made sufficiently large for some uncovered soil around the plant's base. Usually a hole about four or five inches



TOMATOES FIVE WEEKS OLD

Such plants not only grow faster but show a 44 percent increase in yield

in diameter is sufficient. With a smaller opening the tender plants are likely to suffer while they are getting started.

Sometimes plant openings are made by making criss-cross slits in the mulch paper in such a manner that the edges may be folded back as flaps. It is possible to so adjust these flaps that considerable protection from the wind

is given to the young plants. One possible objection to these flaps is that in some places they are likely to offer a barrier to rainfall which otherwise might drain through the openings. Where there is too much rainfall, however, the barrier provided by the flaps may prove to be an advantage.

With carrots, radishes, spinach and other drill crops sown in rows close together, the planting is done between the strips of paper. Each strip acts as a sort of watershed carrying the rainfall direct to the root area. When such a method of using the paper is employed the weed growth is confined to the narrow planting strip, rarely more than two inches wide, and the work of cultivation is reduced to a minimum.

SOME crops, of course, benefit more than others by the use of mulch paper. The heat-loving type of plants, such as pineapples, tomatoes, cucumbers, tobacco, eggplant, peppers and sugar cane, seem to respond best, but many kinds of berries, nursery stock and vegetables, also, probably could use it to great advantage. There is little doubt that as mulch paper becomes more widely known and used that methods of adapting it to crops of all kinds will be developed and its efficiency heightened still more in producing bigger crops, earlier crops, additional crops, and crops cared for with less labor.

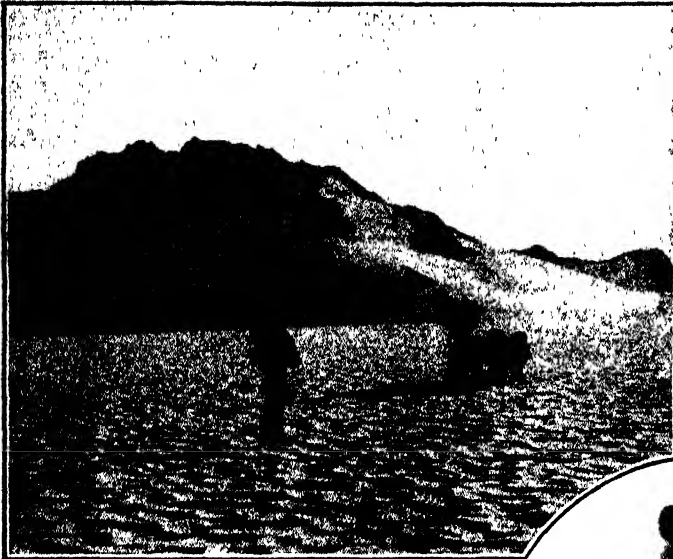
Already, as a result of the success in Hawaii, extensive trials are being made with various crops in Africa, Australia, Asia, the West Indies and Europe, as well as in the United States. The reports of all of them strongly suggest that the practice may become a general one, and that it is soundly economic.

Think what it may mean! No more drought-born famines. No more barren acres. No more ceaseless toil from dawn to dusk in the never ending battle to kill cursed weeds, robbing precious plants of their food. Freedom from fear, freedom from drudgery! At last the man with the hoe may throw away the symbol of his serfdom!



YOU MAY PLANT THEM AND FORGET THEM

Plants grown the old-fashioned way must be cultivated constantly to kill the weeds. With the mulch paper the initial cultivation is the only one needed. The tillage may last several crops



P and A

▲ DANGER LURKS BENEATH ▲

Crossing an area of hardened crust any part of which may conceal a bridged-over crevasse. Picture shows Henry Pigg, a lad of 18, and Jack Kobz, a Swiss, who accompanied Father Hubbard, insert at the right, on his traverse of the 90 mile ice area

▼ MENDENHALL GLACIER ▼

Photograph was taken at the terminal of the glacier and shows a stream flowing from beneath its ice foot



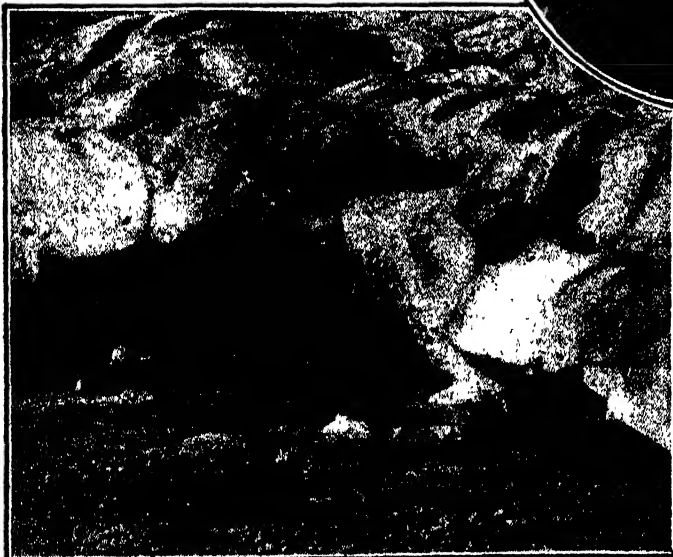
P and A

▲ CROSSING TAKU GLACIER

The surface of a glacier seldom provides smooth sledding. Usually it is a welter of dangerous crevasses into which the unwary traveler may fall to unknown depth, and if not rescued in time will find an icy tomb

▼ WHERE THE TRIP ENDED

From a distance, an expanse of ice of this nature presents a negotiable appearance, but crossing it involves the solution of an intricate puzzle



P and A



Photo by Father Hubbard

Priest-Professor Conducts Daring Exploration

TO demonstrate his belief in the existence of a huge interior mass of ice several thousand miles in area, in the hitherto unexplored region not far back of Juneau, Alaska, Father B. R. Hubbard, priest and professor of the University of Santa Clara, California, has made a remarkable traverse of a 90 mile stretch of the hardest kind of "going." To quote Father Hubbard:

"I attempted the trip with a young Swiss traveler, Karl Tinglay by name, but his unfortunate fall of over 40 feet into a crevasse landed him in the hospital for the rest of the summer. I could find no one else with the necessary experience for so hazardous a trip until I met Jack Kobz, a prospector on the Taku. With his three pack dogs and a student, Henry Pigg, we started off to climb the

face of the Mendenhall Glacier. All that day we skirted ice falls, leaped crevasses, each man roped to a dog, slushed through half melted snow until close to midnight. During the three hours of night we huddled together on a moraine rock until daylight permitted us to stretch our frozen limbs. For two more days and nights we wandered through a labyrinth of rocky *nunataks* and *cirques*, climbed ridges and cliffs bordering rivers of ice until after covering over 90 miles with hardly six hours rest all told during the three days going, we arrived all but exhausted at the end of the Taku Glacier. The results were gratifying, confirming as they did the existence of the huge interior body of ice back of Juneau, and contributing much interesting and scientific data on glacial geology."

The Month In Medical Science

A Review and Commentary on Progress in the Medical and Surgical Field

By MORRIS FISHBEIN, M. D.

Editor of the Journal of the American Medical Association and of Hygeia

Martyrs of Medicine

THE death within one year, in Akkra, in South Africa, of three workers in yellow fever, adds to the long roll of the martyrs of medicine, to the list of physicians and investigators who have died as a result of disease incurred during research for methods to relieve suffering and to prevent death.

Last September, Dr. Adrian Stokes died of yellow fever, at only 40 years of age. He had already contributed greatly to medicine, particularly in the field of bacteriology, and he had shown the possibility of inoculating rhesus monkeys with yellow fever. On May 21, Dr. Hideyo Noguchi, noted Japanese investigator, died of yellow fever in the same place while in the midst of researches attempting to identify the South American form of this disease.

Among the contributions for which Doctor Noguchi was especially noted were pure cultivation of the syphilitic organism; the demonstration of the presence of the syphilitic organism in the brain in general paralysis and in the spinal cord in locomotor ataxia; cultivation of micro-organisms associated with infantile paralysis and rabies; the introduction of the luetin test for syphilis; the introduction of a method for obtaining a bacteria-free vaccine for smallpox; the isolation and cultivation of the micro-organism *Leptospira icteroides* associated with yellow fever, and simultaneously the development of a preventive vaccine and serum for use in treatment. His most recent publication dealt with an organism associated with trachoma in American Indians. For his work he had been

honored by practically every important government in the world.

On May 30, Dr. William Alexander Young, third member of the investigating party, also succumbed to yellow fever.

The roll of medical martyrs, beginning with Servetus and Semmelweis, who died for their opinions, includes, as listed by Garrison in the forthcoming edition of his notable "History of Medicine:"

Daniel A. Carrion (verruugas), Jesse W. Lazear (yellow fever), Alexander Yersin and Hermann Franz Müller (bubonic plague), Tito Carbone (Malta fever), Allen MacFadyen (typhoid and Malta fever), J. Everett Dutton (African relapsing fever), Howard Taylor Ricketts (typhus), Bacot (typhus fever), Thomas B. McClintick (Rocky Mountain fever), William Ironside Bruce (aplastic anemia), Pirrie (kala azar) and Gaspar Vianna of Brazil (postmortem sepsis).

All of these men lost their lives in investigating the diseases with which their names are associated. Almost coincidentally with Röntgen's announcement of the X ray, Albers-Schönberg, in Germany, began his series of experiments. Schönberg died of cancer after suffering repeated mutilations due to the effects of the X ray.

Among others who had anywhere from five to 30 operations as a result of similar investigations and who died eventually of X-ray cancer were Drs. Bergonie, Spence, Blackall, Hall-Edwards and Menard. Associated with these men were many technicians whose lives also were sacrificed to their

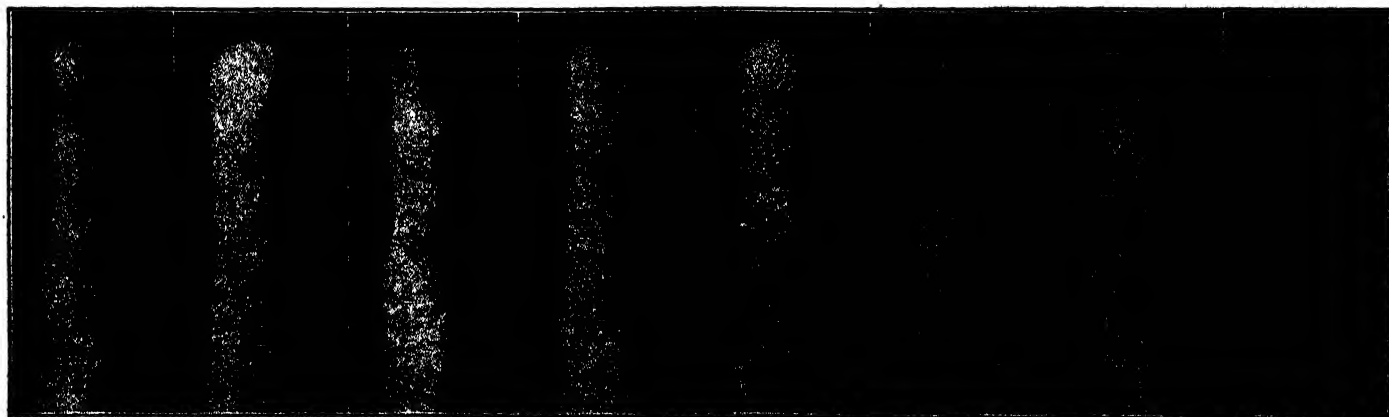
studies. In this country, numerous physicians who devoted themselves to roentgenology before all of the associated dangers were known, have died and continue to die from X-ray cancer.

To this list of physicians must be added also the names of many men who have submitted themselves to inoculation in association with the study of dengue fever, of influenza, of measles and of scarlet fever in order that more might be known concerning these conditions. The names of such famous investigators as John Hunter, Hammond, Carroll, Halstead and Henry Head are included in the list of those who have run definite risks by experimenting on themselves but who recovered from the experimentation.

Creeping Eruption

DURING the rainy portion of the summer in the south Atlantic and Gulf sections of the United States, many people suffer with disturbances of the skin which take a peculiar form. The disease was first described in England in 1875 by R. J. Lee, who noticed the advancing area of inflammation under the skin which he called, therefore, "creeping eruption." Since that time several other physicians have noticed that in certain cases of diseases of the skin a living organism under the tissue burrows through and sets up inflammation.

In 1924, in a clinic held in Jacksonville, Florida, Dr. J. L. Kirby-Smith found 179 such cases among the people who were examined. He made careful microscopical studies of the organisms, picture of which is shown herewith. In



AN EXAMPLE OF THE SKIN TROUBLE KNOWN AS CREEPING ERUPTION

This series of photographs were taken of the same finger in different positions. The creeping eruption was produced experimentally with

a nematode larva obtained in culture from a dog. See explanatory text in these columns as well as other illustrations on the opposite page

the meantime, attempts have been made to find how the organism is transmitted from one human being to another. Both dogs and cats were found to harbor the larvae.

Volunteers were obtained who permitted themselves to be inoculated with larvae from the dog, and within 12 hours the disease was produced in the human being. In fact, larvae from both the dog and the cat were found capable of causing the disease in human beings. Among other names that have been applied to this condition is "ground itch." Not only the larvae mentioned, but also certain fly larvae and other parasites may produce forms of creeping eruption. The condition once discovered is easily controlled by causing the death of the infesting organism.

Metals in Food

OF late there has been much misinformation disseminated by competing manufacturers of kitchenware and by unreliable periodicals in the field of dietetics relative to possible dangers from dissolved metallic substances in food. In order to provide a scientific answer to the question of such dangers Drs. F. B. Flinn and J. M. Inouye of New York, made an investigation with scientific controls. They point out that copper, zinc, manganese, iron, and aluminum are to be found in plant and sea foods in appreciable quantities, that traces of nickel and cobalt are often detected, while lead is practically unknown in nature, except when waters have been contaminated by refuse from some industrial plant.

The metals commonly used in manufacturing cooking utensils are iron, copper, tin, aluminum, and nickel. Zinc is not used because it is easily acted on by weak acids and cases are on record of poisoning from eating

food that has stood in galvanized vessels. Copper, aluminum, and nickel are all acted on to some extent by alkalization or acids contained in food. Aluminum is only slightly attacked by organic acids and readily acted on by alkalies. Tin is most innocuous, but so expensive that it is seldom used for kitchenware.

The question to be answered by the investigation was whether or not a sufficient amount of the metals may

relates to tuberculosis. He feels that the light clothing and the resultant chilling of the body associated with loss of body weight because of the craze for slenderization are the primary factors. Indeed, he says that if these youthful forms, which are nothing but skin and bones, were clothed in rags everybody would be shocked at the terrible social conditions.

The clothing of women including shoes, weighed formerly from two and



LARVA RESPONSIBLE FOR CREEPING ERUPTION

Other forms of the skin disturbance may be produced by other parasites

pass into foods during the cooking process to act as poisons. It was found that the foods ingested with the metals reduced and modified the effect of the metal. Animals refused food having too metallic a taste so that some of the metals had to be given by stomach tubes or in capsules.

Copper, zinc, and nickel are so readily soluble in the acids of fruits, that it was considered inadvisable to recommend their use indiscriminately in vessels for cooking purposes. If the utensils are not kept scrupulously clean salts of the metal will form on the surface and these salts are more soluble than the metals themselves.

It is known that zinc, copper, manganese, aluminum, and tin are regularly found in the human body, although the exact functions of aluminum, tin, and nickel have not apparently been worked out. It was found that most of the metals taken in are promptly passed out of the body in the digestive process. There was no great accumulation of the substances even after three months' exposure.

With relation to aluminum particularly, the authors are convinced that the amount of aluminum taken in does not affect the body, particularly in the germ cells, in any way. There was no evidence that the aluminum replaced the iron in the blood or liver and there was not the slightest scientific evidence of any chronic poisoning taking place from food cooked in aluminum utensils. Large doses of aluminum salts, like copper and nickel, will cause disturbances of digestion, but such excessive doses as would be necessary to bring about such disturbances in the human body simply do not come into the body from the use of cooking utensils.

Women's Wear and Health

GEHEIMRAT RUBNER is one of the leading physiologists of Germany. In a recent statement he has condemned present-day dress of women because of its disastrous unhygienic effects. He points out that the mortality rates for women between the ages of 20 to 26 are increasing all over the world, particularly as

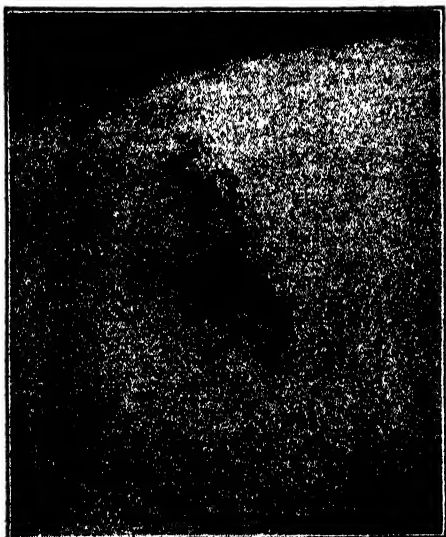
one half to three kilograms, or from five to six pounds. These figures have long since been left behind. Modern clothing weighs less than a pound, and even winter clothing weighs three and one half to four pounds. However, there is no longer, according to Rubner, any such thing as winter clothing, except for the outside coat. In fact, Rubner considers especially unhygienic the fact that underwear has diminished so rapidly that the outer garment, which is a single piece, and practically never washed, serves constantly as a direct covering for, and is in contact with, the skin.

Ptomaine Poisoning

ONCE upon a time everyone who developed any sort of illness after eating was reported as being incapacitated by ptomaine poisoning. In recent studies of outbreaks of such cases in the United States it was found that in almost one third of the cases the diagnosis of ptomaine poisoning had been made on first investigation.

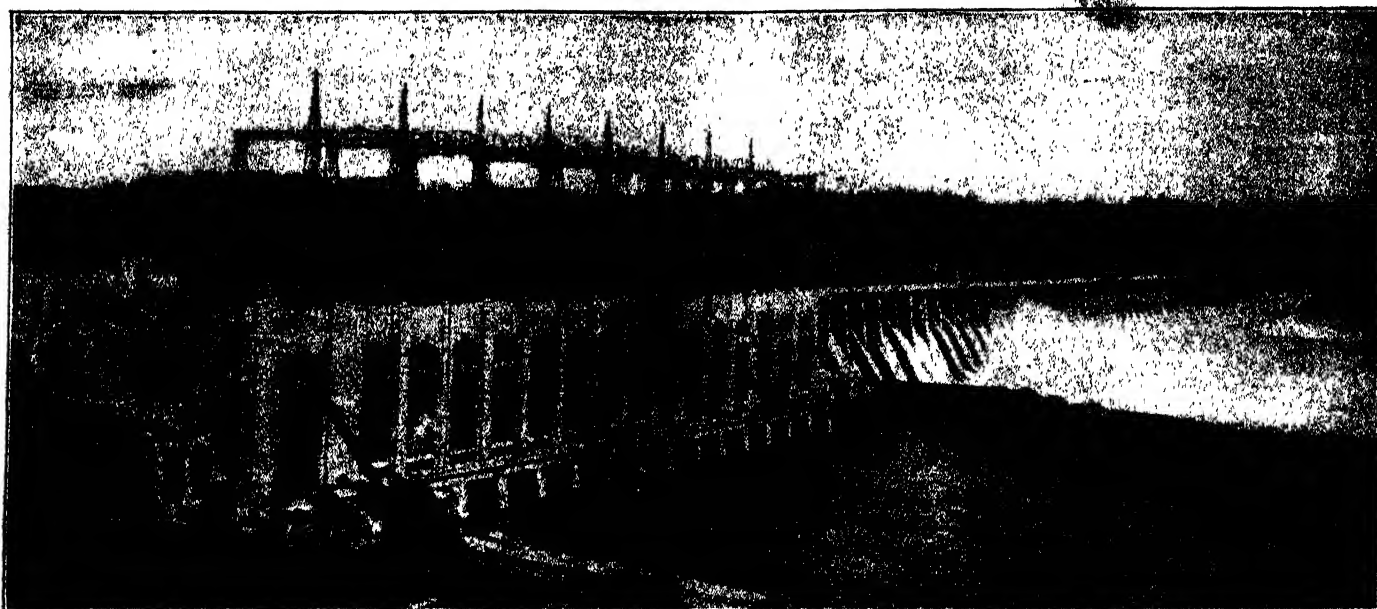
Actually, ptomaines are compounds formed by the action of bacteria on nitrogenous matter. These substances are not at all poisonous as compared with the poisons given off by some bacteria, nor are they in any sense of the word specific poisons. Many bacteria which are not harmful to man may act on food to produce ptomaines, and many bacteria which are distinctly menacing to the human being do not produce ptomaines.

In most instances food poisoning is due to certain types of bacteria associated with food. These are either botulinus germs, which give out a highly poisonous by-product, or germs which have a joint affinity for the intestinal tract and produce various forms of intestinal disease. Food infected with such germs is far more dangerous than food which has merely decomposed due to the action of some bacteria associated with decomposition. If such cases are to be controlled from the sanitary point of view, it is necessary that a scientific diagnosis be made in each instance, and that the word "ptomaine" poisoning be avoided.



ANOTHER ERUPTION

Eight days after inoculation with larvae from a pure culture of Ancylostoma braziliense obtained from a dog



CONOWINGO HYDRO-ELECTRIC PLANT

This project is said to surpass Muscle Shoals and to rank second in the United States to that of the Niagara Falls Power Company. The

dam is 200 feet longer than that at Muscle Shoals. The Baltimore Pike now crosses the river on a 20-foot roadway on top of the dam

Conowingo—Huge Hydroelectric Plant

New Development On the Susquehanna River in Maryland Possesses Several "World's Largest" Features

By A. G. CHERRY

Engineer, Hydraulic Division, Stone and Webster, Inc.

ON the first day of March of this year, thousands of horsepower of electrical energy were sent flashing over the 60-odd miles of transmission line to Philadelphia from the first two generating units of the large hydroelectric plant on the Susquehanna River near Conowingo, Maryland. This date is a little less than two years after construction was started and is three months earlier than the scheduled date of completion of the first unit which was June 1, 1928. In fact, all seven units of the initial installation were completed June 1, six months ahead of scheduled time.

FOR many years, the possibilities for power development in the vicinity of Conowingo have been known and have at various times been investigated by engineers. Previous to 1884, however, the use of the power available was confined to small grist and lumber mills. In that year, an act of the Maryland Legislature authorized a power development at the site but it was not until recently that the nearby markets could absorb enough of the power available to make the development financially practicable.

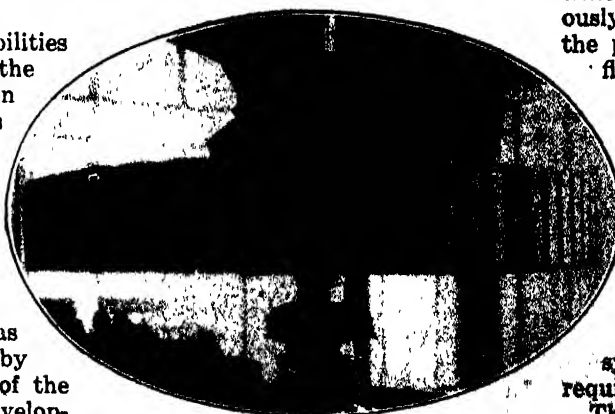
The Susquehanna River above Conowingo drains an area of about 27,000

square miles, including almost one half the area of Pennsylvania and about one eighth of New York state. In the last 27 miles of its travel to tidewater, it drops almost 165 feet. Approximately 90 feet of this drop is utilized by the Conowingo development. The flow of the river is so variable that it is called "flashy." The minimum flow recorded is only 2,200 cubic feet of water per second, while the maximum on record is approximately 750,000 cubic feet per second. Between these two limits, the flow is extremely variable not only from day to day, but

from week to week, and from season to season throughout the year.

NATURALLY, with such a variation in river flow, the amount of power which can be generated will vary periodically. The only economical manner in which these varying amounts of energy can be used to serve the more constant demands of the power market is by co-ordinating the water power with the output of a steam electric system. With such a combination, the water power-plant is so operated that, during periods of plentiful water supply, the units are run continuously to carry the "base" load of the power system, while during low flow periods, the water is stored for the greater part of each 24 hours and is then released at a high rate of flow for the short time required to furnish the power for the daily "peak" load period. Conowingo is interconnected with the steam electric system of the Philadelphia Electric Company which, together with its associated power systems, furnishes the co-ordination required to absorb the water power.

The dam and power station of the Conowingo development are located about 12 miles above the mouth of the Susquehanna River and about four



PLACING A ROTOR

This rotor of one of the generators, together with its shaft, weighs 808,650 pounds

miles above the lower tidewater in the river.

The reservoir formed by the dam extends nearly 15 miles upstream and is over a mile wide at many points. Submerged beneath its waters, lie miles of the Columbia and Port Deposit branch of the Pennsylvania Railroad, the site of the entire old town of Conowingo, the mile-long bridge which carried the Baltimore Pike across the river, and many other buildings, structures, and highways of lesser importance.

THE dam, which is nearly a mile in total length, is of the gravity type, built of mass concrete, and is divided into three general sections. It contains, exclusive of the power station head-works, approximately 430,000 cubic yards of concrete. The spillway or over-flow section, 2385 feet long, occupies the center section; the power station headworks takes up 950 feet adjacent to the west bank; while the remainder of the length, principally on the east side of the river, is filled by the bulkhead, or abutment, section.

The spillway section is designed to pass a flood over 10 percent in excess of the largest flood on record without raising the level above the normal. To accomplish this, the spillway is provided with 50 steel crest gates, each 22 feet, six inches high, with a span of 41 feet, and weighing about 42 tons. For minor regulation of reservoir levels, three additional gates of the same span but only 10 feet high, are provided. All these gates are raised and lowered by 60-ton cranes, three of which travel on a 20-foot gage track on a bridge over the dam. Electric heaters are provided to keep the gate guides clear of ice in winter and compressed air is released under water in front of each gate to prevent the formation of surface ice.

The present development provides



EXTERIOR OF THE POWER HOUSE DURING CONSTRUCTION

Looking toward the west bank of the river from below the dam. Steel and other materials were brought to the job by rail on the road shown here braced to the side of the building

seven main water-wheel units of 54,000 horse power capacity each, or a total installed capacity of 378,000 horsepower, which is the largest amount of power, either steam or water, that has ever been installed at one time in a single plant. The ultimate development of the site calls for four additional units of approximately the same capacity, and the headworks section of the dam has been so constructed that these units may be installed whenever the additional capacity is required.

The over-all dimensions of the present power station section, including the headworks, are as follows: length 662 feet, width 176 feet, and height to top of switching structure on the roof 210 feet. The length of the power station when completed for the eleven units will be 950 feet.

The power house is divided laterally

into three general divisions: the generating bay, electrical bay, and head-works or intake. In addition, space is provided for machine shops, offices, storerooms, assembly and dismantling area for large equipment, and space for various other necessary auxiliary equipment. The 220,000-volt switching station covers nearly the entire area of the power station roof.

THE headworks section is designed as a continuation of the dam and contains the intakes to the water-wheel units. There are two intake openings 22 feet wide by 43 feet high for each main unit. By gradual transition these rectangular openings merge into a single circular water passage 27 feet in diameter at the entrance to the water wheels. The intake openings are protected from trash by sectional steel racks which can be cleared of any



THE BUTTERFLY VALVE CLOSED

The largest ever constructed, one of these vertical-shaft pilot valves regulates the flow of water from the intake to each water-wheel case



LIKE A STOVE-PIPE DAMPER

In the open position. The entrance to the wheel here is 27 feet in diameter. The valve disk, operated hydraulically, weighs 155 tons



DAM SPILLWAY SECTION

An early stage in the construction of the dam, from the upstream side, with temporary railroads above and below

accumulation by a motor-driven raking device. Provision is also made for the intake openings to be closed by lowering steel sectional head gates in front of them. These head gates are handled by the same gantry cranes that operate the gates on the dam.

The generating bay, as its name signifies, houses the seven main generating units. The water wheels have a rated full gate capacity of 54,000 horsepower under the normal head of 89 feet and revolve at 81.8 revolutions per minute. Each wheel requires approximately 6000 cubic feet, or 375,000 pounds of water per second, to develop the full power. The units which are the largest in physical size in the world, are of the vertical shaft type and have plate steel spiral scroll cases.

TO regulate the flow of water from the reservoir to each water wheel, a vertical-shaft pivot valve called a butterfly valve, is placed between the lower end of the intake and the entrance to each water wheel scroll case. These valves, which operate in much the same manner as the common stove-pipe damper, are by far the largest ever constructed, being 27 feet in diameter. Each disk alone weighs about 270,000 pounds and when closed against the pressure of water in the reservoir, must withstand a thrust of about 3,000,000 pounds. The valves are hydraulically operated, using oil under 175 pounds pressure per square inch. Four of the water-wheel units with valves, were furnished by the Allis-Chalmers Manufacturing Company of Milwaukee, and the remaining three by the I. P. Morris Corporation of Philadelphia.

Connected directly to these water wheels are the seven main generators,

each of 40,000 kilo-volt-ampere capacity at .90 power factor, and generating electrical energy at 13,800 volts. The outside diameter of each of these huge machines is 37 feet, while the rotating part is about 33 feet in diameter, and weighs over 250 tons. This weight, together with the rotating parts of the water wheel and the thrust of the water passing through the wheel, totals about 600 tons, or the equivalent of two of the country's largest locomotives, and is all supported by a single thrust bearing 80 inches in diameter, located near the top of the generator bearings. The unit is held in alignment by two habbitted guide bearings on the generator shaft and one adjustable bearing made from lignum vitae wood, on the water-wheel shaft, the latter being

water lubricated.

A motor-driven fan is provided to cool each generator by drawing about 100,000 cubic feet of air through the machine every minute. Each main generator has a direct-connected 715 kilo-volt-ampere auxiliary generator, which furnishes energy at 480 volts for operating the motor-driven exciter, governor oil pump, and vent fan of that unit.

FOUR of the main generators were manufactured by the General Electric Company and three by the Westinghouse Electric and Manufacturing Company.

In addition, two separate station service water-wheel-driven generating units of 1900 horse-power each, are installed to furnish power for station lighting, crane operation and various other auxiliary services. The water wheels for these units were constructed by the S. Morgan Smith Company of York, Pennsylvania, and the direct connected generators are of Westinghouse Electric and Manufacturing Company make.

There are two main floor levels in the generating bay. The auxiliary equipment is, for the most part, located on the lower, while the upper is the main operating floor. A balcony provides access to the generators, and supports the motor-driven exciter units.

The electrical bay contains the low-tension bus

structure and equipment, the main and station service transformer banks, the main control equipment, et cetera, including ten 13,800 volt oil circuit breakers.

The switching station on the roof, which possesses seven 220,000 volt oil circuit breakers, distributes the power after it has been stepped-up to 220,000 volts by the main transformers, to two transmission lines protected by two 220,000 volt lightning arresters.

FROM the switching station, the transmission lines cross the river below the dam in two spans of 1500 feet and 2300 feet respectively, being supported by four river-crossing towers of structural steel about 228 feet high. The power is carried over 58 miles of double-circuit transmission line to the large switching station at Plymouth Meeting, Pennsylvania, on the outskirts of Philadelphia, where it is stepped-down to 66,000 volts and distributed through the various sub-stations and plants of the Philadelphia Electric Company's system. The Plymouth Meeting sub-station, covering an area of 40 acres and controlling 750,000 kilowatts of electrical energy, will be the largest switching station in the world.

The engineering and construction operations have been carried out under the supervision of the Chief Engineer of the Philadelphia Electric Company, by Stone and Webster, Inc., of Boston, who associated with themselves in the construction of the dam, The Arundel Corporation of Baltimore. The Conowingo switching station and transmission lines were designed and constructed by Day and Zimmermann, Inc., of Philadelphia.



PLACING SERVICE GATE

Fifty of these gates, 22 feet high and 41 feet wide, and weighing about 42 tons, were installed on the spillway



EXTERIOR OF THE DINER

A general outside view of the de luxe motor dining car, and its "advance" or advertising car. The bus chassis and motor were carefully selected for safety of operation and for efficiency. A Hall-Scott engine, mounted in a Fageol safety coach, furnishes the motive power

The "Lunch Wagon" Modernized

BUILT for the purposes of food demonstrating, food and beverage advertising in general, and for dining, the motor bus illustrated in these columns is equipped with many unusual features—unusual, that is, for a mobile unit of its kind.

In the forward end, as illustrated, there is a complete up-to-date kitchen. Under the soda fountain at the service counter, there is an electrical refrigerating plant, operated from a portable generating unit. The latter also serves the lighting and other electrical equipment. The entire kitchen compartment is floored with tile.

The sanitary arrangements are very complete, comprising a small marine type schooner lavatory.

As a motor bus, the "Oasis," as it is called, has proved to be completely roadworthy. A trip from Philadelphia to Florida, and back to Atlantic City, was made without motor or tire trouble during the entire journey.



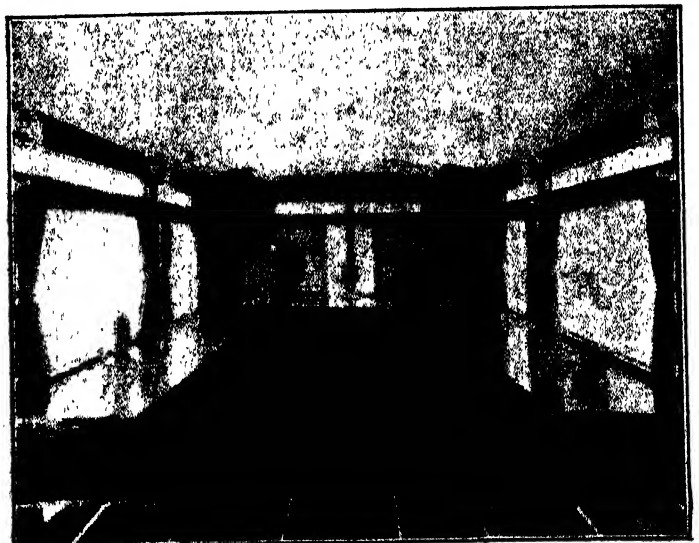
"LUNCHEON IS SERVED"

The interior of the luxurious motor dining coach, looking toward the driver's place, which is beyond the "kitchen." Tables can be used in either of the positions shown in the photograph



CLOSE VIEW OF THE KITCHEN

In the foreground is a completely equipped soda fountain, at the right is a meat slicer, at the left a stove, and in center is the coffee urn



LOOKING TOWARD THE REAR

In the background may be seen ample drawers for supplies and the like. Long windows all around furnish an abundance of sun-light



A MIMBRENO

One of the mummified figures which were found buried under the floors of the houses

A PREHISTORIC civilization, distinct from that of the Pueblos and the cliff-dwellers, has been opened up by recent research along the Mimbres River in southwestern New Mexico. Excavations made in this region have brought to light an ancient race whose customs, arts, and architecture, were different from any of the other semi-civilized people who once inhabited much of the southwest.

Very little was known about this region until it was visited in 1923 by J. Walter Fewkes who made a collection of the pottery and implements of the people for the United States National Museum. Most of this collection was purchased from ranchers and other residents of the country who had gradually collected the articles from the numerous ruins scattered throughout the Mimbres valley.

SOON after Mr. Fewkes visited the region, the New Mexico State Museum and the Peabody Museum sent expeditions to southwestern New Mexico, and the work of excavating some of the ruins was started. This research has been continued during the summer months for the last three years. Although only two of the ancient cities



EXQUISITE POTTERY

The Mimbrenos were expert potters. Who but an expert could make such a bowl?

Who Were the Prehistoric Mimbrenos of New Mexico?

Evidences of a Peculiar People Whose Culture Differed from that of the Other Early Inhabitants of the Southwest

By GEORGE A. WALLIS

have been scientifically excavated, enough has been learned about the inhabitants to show that they were a distinct nationality and apparently antedated both the Pueblos and the cliff-dwellers.

Southwestern New Mexico is a mixture of mountains and wind-swept desert. Rising in the mountains and

to have been the deciding factors in selecting the sites for their cities. Many of the villages are found in level valleys; and, unlike the cliff-dwellings and Pueblos, show no desire on the part of the inhabitants for defensive locations for their homes.

The typical Mimbreno house is a rectangular room of not more than 12 by 14 feet. These buildings may be isolated or joined together in small groups. Most of the houses were built of stone and adobe. Many of the houses were partially underground with walls and roofs rising only a few feet above the surface of the earth. The buildings were entered from the side and not through an opening in the roof, as is the case with the Pueblo dwellings. These entrances were almost always located on the south or east side of the houses and were probably made there in order to admit the maximum amount of sunlight. Fire pits are found near the center of the rooms; the smoke apparently found its way out through a hole in the roof.



A PICTOGRAPH

Hundreds of fine paintings of this type have been found on the cliffs of the southwest

THE ruins are in a poor state of preservation and nowhere rise above the surface of the earth. Piles of tumbled down stones mark the site of the buildings, and the walls can be traced by shoveling away the sand that has been accumulating about them through the ages. The walls are of rough stone, held together by adobe mortar. Heavy cedar beams which

flowing southward is the Mimbres River, a small stream fringed with willows. A short distance north of Deming, New Mexico, it is swallowed up by the desert sands; although during rare intervals of flood, its waters reach Palomas Lake in Chihuahua, Mexico. The ancient ruins are found all along the banks of the Mimbres and its tributaries, wherever cultivatable land is found. The villages range from farm sites with a half dozen buildings to towns of three or four hundred buildings. Water and farm land seem



THIN AND DELICATE

A closer view of a basin shown in the group to the right on the opposite page

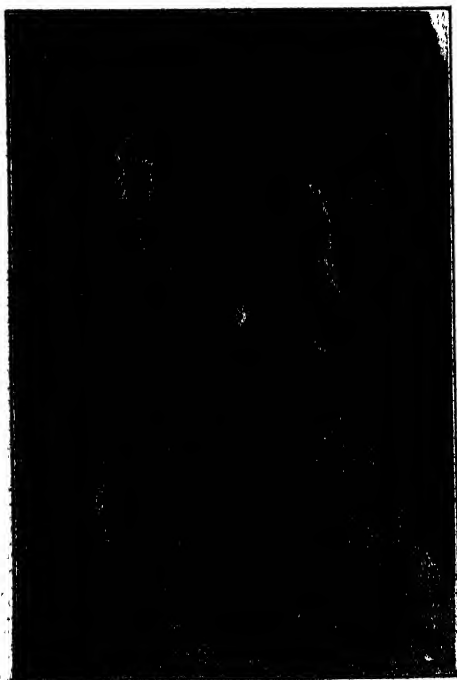
once supported the roofs can still be found in places where they have been protected from moisture.

The Mimbrenos were an agricultural people. Ears of Indian corn, which were preserved by being half burned and charred, have been found in dry places in the ruins. Numerous pestles and metates found in every ruin attest to the large amount of grain ground.

The Mimbrenos were unexcelled as potters, and the inside of their bowls and the outside of their pitchers and vases are beautifully decorated. Pictures of deer, mountain sheep, antelope, bear, turkey, quail, and rabbits are painted on the Mimbreno ware with a realistic skill unequaled by any of the other ancient inhabitants of the southwest. Drawings of fish show that there were fish in the shallow waters of the Mimbres River. Besides the drawings of animals, the ware is decorated with hundreds of beautiful geometrical designs. The figures are in black or brown on a white background. The worn bottoms of the vessels indicate considerable use.

ASIDE from the practical use of the pottery in the daily life of the people, it had an important place in the burial ceremonies. Some pottery is found in nearly every grave; and a bowl, with a small hole broken in the bottom for the occasion, is usually found placed over the head of the skeleton.

The dead were buried under the floors of the houses in the corners of the rooms. The limbs of the deceased were sometimes extended but more often flexed. The aridness of the region has helped a great deal in preserving skeletons of these people who

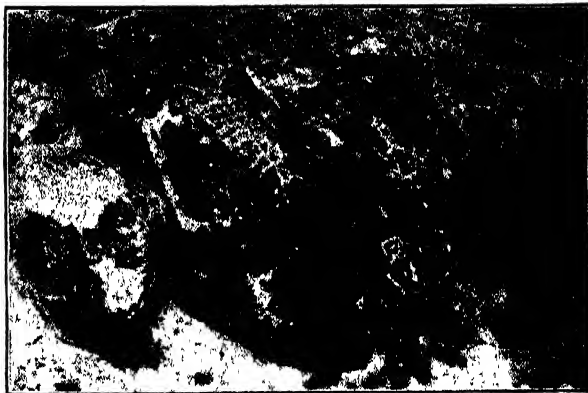


SIGNIFYING WHAT?

What these photographs mean is unknown. Possibly they do not all have significance

PICTOGRAPHS

Drawings made on the rocks, whether by pigments or etching or both, were left by the American Indians in a host of places in the west. They were an attempt at writing and in many cases their meaning may be deciphered. Some of them are fanciful; for example, those which, resembling a dinosaur, caused a real stir in the west not long ago



disappeared centuries ago. A general flatness at the back of the skulls suggests that the babies were strapped to a board not unlike the way in which other tribes of Indians are known to have carried their young.

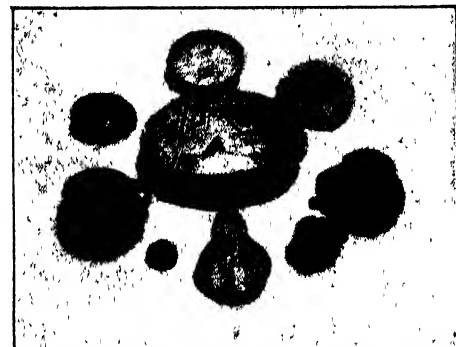
Hundreds of fine pictographs portraying the customs and traditions of the people have been found on the cliffs near their homes. Some of these are painted in colors that have endured through the ages. Others are carved in basalt and sandstone.

The large number of beads and bracelets made from sea shells indicate that the Mimbrenos carried on trade with tribes living on the coast. In 1925, Mr. E. R. Eisele of Fort Bayard, New Mexico, found a small copper bell in a ruin near Hanover, New Mexico; and since that time several others have been found. The exact origin of the bells has not been determined, but they suggest that the Mimbrenos may have been in communication with the copper-working tribes of Mexico. The bells are, so far, the only metal objects found. And although these people lived in a region where copper is now being mined from open pits with the use of steam shovels, there is nothing to indicate that they understood the working of metals.

NO circular, underground *kivas* like those of the Pueblos and cliff-dwellers have been found; although a rectangular room 25 by 30 feet, constructed underground and no doubt used for ceremonial purposes, was found in the Cameron Creek ruin, which was excavated in 1925 by the New Mexico State Museum. The absence of the *kivas* and the isolation of the buildings of the Mimbrenos, show a lack of relation to the cliff-dwellers and the Pueblos.

A few villages which have been identified as belonging to the Casa Grande people of Mexico have been found among the Mimbreno towns along the lower course of the Mimbres River. The villages are easily distinguished by comparing the pottery. Mimbreno towns which were abandoned and later occupied by the Lower Gila people of

Arizona have been found. That the houses were built by the Mimbrenos is evident from the pieces of broken Mimbreno pottery found in the adobe walls. The later occupation of the buildings by the Lower Gila people is shown by the pieces of Gila pottery found in the floors and around the buildings but nowhere in the above walls. This tends to prove that the Mimbrenos



MORE POTTERY

The delicacy and thinness of the work and the fine designs on its surface are notable

were contemporaneous with or older than the prehistoric, city-building people of southern Arizona.

The difference in the architecture and the absence of the round *kiva* shows that the Mimbrenos were not influenced by the wide-spread Pueblo and cliff-dwelling culture of the southwest. This, together with the poor condition of the Mimbreno ruins, has led archeologists to believe that the Mimbrenos preceded these people. The Mimbreno ruins nowhere rise above the surface of the ground, while pueblos and cliff-dwellings are still to be found in a good state of preservation.

Just when the Mimbrenos came into the country and why they disappeared is uncertain, but they were apparently absorbed or exterminated by the savages. No great number of spear and arrow heads are found in the Mimbreno ruins. This suggests that they were not a war-like people and were likely to fall victims of invading tribes. The nomadic Apaches occupied the country when it was first explored by the Spaniards.

The Story of the Shade Roller

Five Factories and Two Thousand Employees Today Are Kept Busy Producing the Spring-Operated Window-Shades Which Stewart Hartshorn Patented in 1864

By MILTON WRIGHT

YEARS ago, long before the Civil War, a little boy had a strange desire. He would build a city. It would be not a mere collection of buildings of all sorts with stores and offices and factories set up each according to the whim of a different owner, but it would all be planned by the little boy. There would be no factories, no stores, but only homes, stately homes of stone, each strikingly individual, yet harmonizing with its neighbors. There would be no straight, hard streets, but winding roads, tree-shaded. It would be a dwelling place of beauty.

Between that desire and its realization is a wide chasm of years. It must be bridged, and it is of the bridging we would speak—of those years of business activity in which a fortune was made from a little invention, years in which the name of Stewart Hartshorn became a household word in a very literal sense, years in which windows throughout the length and breadth of the nation were fitted with the invented article—the spring shade roller.

TO learn the story of the invention we sat with Stewart Hartshorn in his New York office.

"How did you come to invent the spring roller for window shades?" was our first question.

"I was in the window-shade business," he replied.

"Then the business was not founded on the invention?"

"No. The invention grew out of the business. My father, Jacob Hartshorn, and his half-brother, John, had bought a patent for a spring shade as early as 1848, and they made shades according to it, but they were not practical. In 1855, they devised a different one and took out a patent. It was not greatly different in principle from the roller we have today, except that they put the pawl, or catch, on the bracket instead of on the roller.

"My father died in 1859 and I shouldered the burden of carrying on the business. It wasn't much of a business, as far as size went. I would get an order from a householder or store-keeper for window shades, mea-

sure the windows, make the shades, put on rollers and place them on the windows. When business was especially good I had one man to help me.

"Now it seemed to me that window shades that rolled up and down were not as convenient as they should be. They got out of order easily and there were strings which were always getting in the way of the side of the window or with the curtains or draperies. Why not, I asked myself, have the shade roller operable by power within itself rather than by pulleys or balances out-

patent on a practical shade roller."

"Have you ever been called upon to defend that patent?"

"Yes, indeed. A successful invention means lawsuits. I went through a number of such experiences; they would keep on developing from time to time as long as the life of the patent endured. In every case, however, the judges decided in my favor and the validity of the patent was established beyond question."

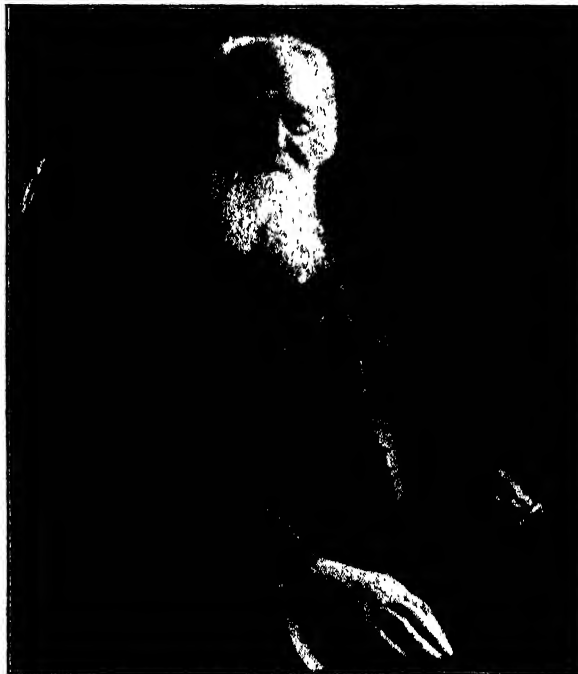
"Did you try to get someone to take your patent off your hands either by outright purchase or on a royalty basis?"

"No, although I know that is the ordinary disposition. Most inventors try to make their money by selling their patents, but I stuck to the idea of developing the invention and the business myself. After I had perfected the new type of roller shade, I still did the whole job myself—getting contracts to fit up windows, getting shades, combining them with rollers, hanging them up and so on. There was some difficulty in getting people to see the advantage of the new kind of shade roller—there always is difficulty in getting people to adopt something new—but the resistance began to wear away in time.

"THE next step in developing the business was to get the upholsterers to use my invention. I was not then distributing throughout the country, but only in and around New York. Steadily the business grew and with it

there were not only increasing complexities of business procedure, but endless details in improving and perfecting the shade itself.

"In about three years imitators began to appear, for by that time the business had grown to a point where it became an object of interest to others. Rival shade makers began to make a roller like mine and I employed a well-known lawyer to stop them. This sort of thing was repeated over and over again for years. My patent, by the way, was one of the first to run for seventeen years. Prior to that time the life of a patent was fourteen years, but just before mine was granted



A PHILOSOPHER NOW

"The inventor must have as his object an invention that is good," says Hartshorn. "Then money may follow"

side the roller where they are in the way.

"On the face of it my idea seemed impracticable. I had two principles with which to work—gravity and centrifugal action. I could pull down the shade and release the ratchet or pawl, and then let go. The spring would pull it up immediately and the pawl would not have time to drop into the notch and hold the shade down at the desired height. If I let go slowly, however, it would work. By experimenting I finally arrived at the present principle—controlling the action of the shade roller through the roller itself—a principle which has never been altered. In 1864 I took out my first

the law was changed and the longer period provided for."

How many millions of shade rollers have been on the Hartshorn principle is a matter of the wildest speculation. Today his company employs about two thousand workers. Five factories are in continuous operation, one at Newark, N. J., devoting its entire output to steel wire, one at Muskegon, Mich., making rollers both wood and metal, one at Toronto, Canada, also making rollers, one at Goldville, S. C., where cotton is spun and woven, and one at Oswego, N. Y., for the finishing of shade cloth. When the whole world goes to bed at night it pulls down the shades on a Hartshorn type of roller.

Surely the inventor of such a product would have a word of advice helpful to other inventors, we thought. We determined to ask him.

"Mr. Hartshorn," we said, "what suggestion would you make from your experience to other inventors whose success is yet to be achieved?"

"Well," he replied with a smile, "I would suggest that they let shade rollers alone."

"Why? Have you noticed that inventors have any tendency to go in for shade rollers?"

"Yes, indeed. About one a week is submitted to us. None of them we think practical. In thirty years only one that has been brought in here has seemed to have any value, and that one was so closely paralleled by another developed just about the same time, that the similarity was fatal for both parties.

TO be practical is the best advice I can give inventors. Many an impractical invention is made and patented, only to rest in obscurity on the shelves of the Patent Office, with the inventor having spent time and money and energy for nothing. Years later such an invention comes to light and is cited against a really worth while invention for which a patent is being sought. The multiplicity of clauses and claims in such patents makes it almost vain to try to cover

think they have something new. Great is their surprise when they learn that hundreds of others have been doing the very thing they have been working on."

"Have you ever tried inventing outside of the shade roller field?"

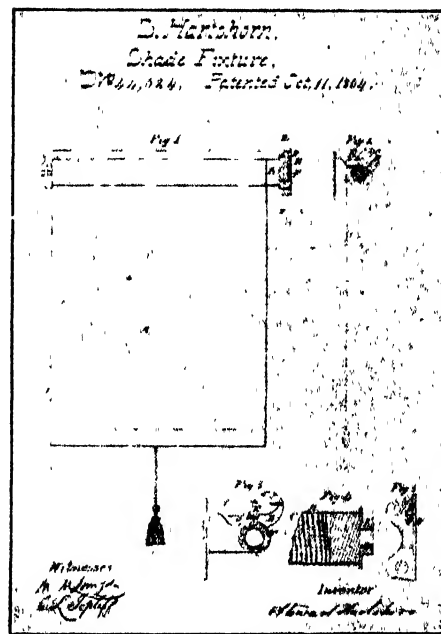
"O, yes. After the Civil War, when all the slaves had been freed, it was felt there was a great demand for a mechanical cotton picker. I tried my hand at it. I got balls of cotton from the south and I evolved a machine that would work to a limited degree. When I applied for a patent an interference was declared with an inventor in Texas and one in Brooklyn. The Texas man's was somewhat like mine in principle; it had a device like an elephant's trunk to reach out and suck up the balls; my machine straddled the rows and sucked them up.

SOME of the ideas I had were at least original. I remember observing that people were accustomed to walk faster in cool weather than in hot weather. From this observation I proposed to apply the bellows principle to the soles of shoes with a tube system running under the clothing, so that the faster a person walked the cooler he would be."

"Did you patent that invention?" we asked.

"Not yet," he laughed. "It was just one of those things. Firearms were something else I became interested in; they have intrigued lots of us. I was deeply interested in working out a new kind of cannon at one time. A cannon, I reasoned, takes a lot of metal. I'll make a gun that won't have the bullet inside, but I'll have the projectile strung on a central rod, like a doughnut. I still had the breach to contend with but I could overcome that nicely. I could groove the rod the same as the barrel is grooved in an orthodox cannon. I made a wooden model of the invention. Eventually, however, I decided to give up the invention. The world had enough things to kill people without my adding something, I reflected. I was aided somewhat in

"Mr. Hartshorn," we interrupted, "there is an old saying that necessity is the mother of invention. Would you say that an inventor is more likely to succeed if he is spurred on



CALLED A "SHADE FIXTURE"

With a single claim this patent was involved in constant litigation but always won

by the necessity for making money?"

"No. The moment a man is contriving something for the purpose of making money, the probability ceases that he will produce something with money-making possibilities. It's like one of those old violin makers. If he had been thinking of the money he was going to get he would not have turned out a priceless masterpiece. The inventor must have as his purpose the making of an invention that is good. Then money may follow.

"When it comes to the making of money from a good invention then you must feel your way as you go. An inventor or manufacturer is foolish if, in his enthusiasm, he turns out something new in great quantities, hoping to make a fortune in a hurry. A man can never know the full value of his invention until he tries to market the invented article. The public must decide the matter for him, and the decision will not be in his favor unless the invention is right."

REVOLUTIONARY IN PRINCIPLE

Before 1864 there had been spring-rollers but the springs were on the window frames, the shades being held in place by cumbersome counter-weights

adequately and validly an invention that is useful.

"Frequently inventors go in for something they know nothing about. In their ignorance of the state of the art their enthusiasm leads them to

reaching this philosophic conclusion by the fact that I couldn't get my bullet to leave the gun."

"These are the things every inventor will do and you can't stop him, try how you will."

AND so Stewart Hartshorn builded upon his invention the business and the fortune that made it possible to realize the ambition he had held as a boy—to plan and build an ideal home community. It is at Short Hills, New Jersey. Fifteen hundred acres it covers—the houses peeping above tree-shaded lawns set back from winding roads—a dwelling place of beauty destined to stand as an enduring memorial to the man who made an invention the world found worth-while.

The Origin of the Cosmic Ray

*Evidence for the Continuous Creation of the Common Elements Out of Positive and Negative Electrons, As Presented to the National Academy of Sciences**

By R. A. MILLIKAN and G. HARVEY CAMERON

Norman Bridge Laboratory of Physics, California Institute of Technology

THE evidence obtained from the study of cosmic rays that the more stable and more abundant elements like helium (abundant in the heavens), oxygen, silicon and iron, are being formed *at the present time* out of the primordial positive and negative electrons, the former of which is the nucleus of the hydrogen atom, may be briefly summarized as follows:

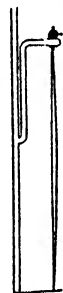
First. The pilot-balloon experiments of Millikan and Bowen¹, in which they sent up recording electroscopes 0.92 of the way to the top of the atmosphere and in which the absorption coefficient of the cosmic rays at, or near, the top of the atmosphere came out of the same order of magnitude as that found near sea-level², show conclusively that these rays consist of a definite and distinct region of spectral frequencies, or oscillations, a hundred times more rapid than those produced by the most powerful sub-atomic changes heretofore known, namely those accompanying radio-active processes.

OTHERWISE stated, these experiments show conclusively that there are no radiations of appreciable intensity entering the earth's atmosphere having frequencies intermediate between those of the gamma rays and those of the cosmic rays. For, since the hardest gamma rays are capable of penetrating a thickness of about 70 centimeters of water, while, as indicated below, the cosmic rays are capable of penetrating 70 meters of water, and since penetrating power increases approximately as frequency, if rays of appreciable intensity came into the atmosphere having frequencies between those of gamma rays and those of the cosmic rays they would of necessity have caused the rapid discharge of an electroscope which rose to within the equivalent of 80 centimeters of water of the top of the atmosphere, the whole of the earth's atmosphere being the equivalent of 10 meters of water. No such rapid discharge took place; hence there are no strong radiations entering the earth's atmosphere in that particular region of frequencies.

Second. The experiments of Milli-

kan and Cameron of the last summer and fall made in deep, high-altitude California lakes, with new electroscopes eight times more sensitive than those the authors had theretofore used, brought to light the definite proof that the cosmic-ray spectrum consists of definite bands, like those of neon or mercury lamps, containing spectral lines as much as three octaves apart, the highest frequency band having so enormous a penetrating power that it passes through as much as 200 feet of water (18 feet of lead) before becoming completely absorbed.

This discovery of a banded structure in the cosmic rays shows that they are not produced, as are X rays, by the impact upon the atoms of matter of electrons which have



ELECTROSCOPE

When charged the filaments repel one another. Cosmic radiation discharges them

acquired large velocities by falling through powerful electrical fields as we earlier suggested³—the fields needed to produce frequencies of the order of the cosmic rays would be at least 150,000,000 volts—(3000 times as great as the field existing in X-ray tubes)—but that *they are rather produced by definite and continually recurring atomic transformations involving very much greater energy-changes than any occurring in radio-active processes.*

The proof of the banded structure of the cosmic-ray spectrum is found in the fact that the new ionization-depth curve (Figure 1), when taken in connection with the sounding balloon data, which is seen to be of very much higher resolving power than any heretofore obtained, shows a nearly constant absorption coefficient from close to the top of the atmosphere down to about sea-level, 10 meters below the

top, then bends quite suddenly and uncovers below 15 meters a new absorption coefficient, of only about one sixth the former value which continues down to 70 meters below the top with but little further change. The cosmic rays, therefore, consist of at least two, possibly more, (see below), radiation bands of absorption coefficients, (and therefore, roughly, also of frequencies) in the ratio 6 to 1. The sharpness of the bend in the ionization-depth curve is completely incompatible with any general distribution of the frequencies of cosmic rays, like that found in white light, or in the general X-radiation which is produced by the bombardment of the atoms of a target by high-speed electrons (cathode rays).

Third. If the Einstein special theory of relativity may be taken as a sound basis of reasoning—and no results predicted by it have ever thus far been shown to be incorrect, while it has many striking successes to its credit—then it follows that radiant energy can never escape from an atomic system without the disappearance of an equivalent amount of mass from that system, these relations being contained in the now well known and universally used equation of Einstein (1905) $Mc^2 = E$, where M is mass in grams, c is the velocity of light in centimeters per second, and E is energy in ergs.

NOW through the recent, very exact work of Aston⁴ we know the mass of every one of the atoms with a great deal of certainty, and we can therefore compute the amount of ether-wave energy that can be generated by any sort of atomic transformation that can take place, and knowing this energy we can compute with the aid of the Einstein equation the frequency, and with the aid of the Dirac formula⁵ the penetrating powers of the rays resulting from all possible atomic transformations. Such studies reveal the fact that there are no possible transformations capable of yielding rays of the enormous penetrating power observed by Millikan and Cameron except those corresponding to the building up or creation of the abundant elements like helium, oxygen, silicon and iron out of hydrogen, or, in the case of the last two

*Proceedings National Academy of Sciences, 14; 6
¹Millikan and Bowen, Phys. Rev., 22, 198 (1923) and
Phys. Rev. 27, 353 (1926)
²Millikan and Cameron, Phys. Rev. 31, 163 (1928)

³Millikan and Cameron, Nature, 121, 24 (1928)

⁴Aston, Proc. Roy. Soc., 115, 487 (1927)
⁵Dirac, Proc. Roy. Soc., 109, 206 (1925)

elements we mentioned, out of helium.

The entire annihilation of hydrogen by the falling completely together of its positive and negative electrons might be an additional possibility, but it can be eliminated in this case for two excellent reasons. The first of these reasons is that there is practically no place whatever for such a radiation to occupy in the observed ionization-depth curve (see Figure 1), for it would be between four and five times more penetrating than the radiation that has the smallest absorption coefficient mentioned above. The ionization due to it, if it exists, would then have to be included in the 2.4 ions which represents the "zero of the electroscope" as shown in the figure. But this 2.4 ions is only about one tenth of the observed ionization at the top of the curve, viz. 21 ions, this top-most reading corresponding to a depth of 1 meter below the surface of Gem Lake. Therefore this hypothetical radiation can have nothing to do with the observed ionization-depth curve much above the reading 2.4, and below it there is of course room only for a radiation relatively negligible in intensity in comparison with the softer rays that are responsible for the observed curve.

The second reason is that this hypothetical radiation, if it were present, would of necessity be homogeneous, and could not therefore exhibit the banded structure shown by the observed cosmic rays. Whether, then, this act of the entire annihilation of the hydrogen atom through the coming into complete coincidence of the positive and negative electrons takes place or not, it can certainly be eliminated as a cause of the observed cosmic rays.

There remains, then, no other atomic transformation in which sufficient mass disappears to create the observed cosmic rays except the aforementioned atom-building processes.

IT is important to note that no step-by-step process of building up, or for that matter of disintegrating of atoms, in which one positive electron or one alpha particle is added or subtracted at a time, will suffice for the generation of the cosmic rays, since the Einstein equation tells us that in no case can such a transformation produce rays of more than from one fourth to one twenty-fifth of the observed penetrating power. The observed extraordinarily penetrating cosmic rays present, then, when taken in connection with Einstein's equation and Aston's findings, not only the first direct evidence that the more abundant elements are now in process of being created out of positive and negative electrons, but they also present the first indications as to the general character of the specific act or acts by which the atom-building process goes on.

So far we have used only the general or qualitative evidence, but it will be seen that from it alone the conclusion is scarcely escapable that the powerful cosmic rays here studied can be produced only by the creation in a single act, rather than by a step-by-step process, of some, at least, of the common elements out of the primordial positive and negative electrons.

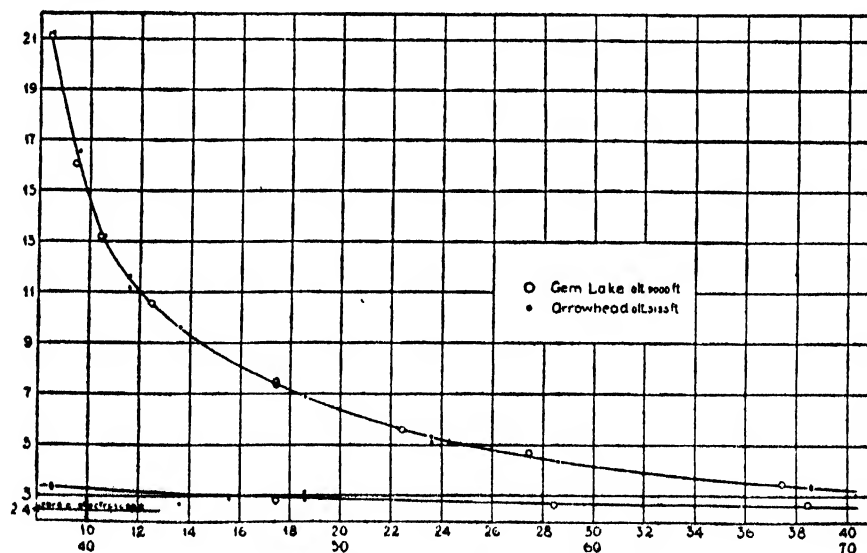
Fourth. The evidence herewith obtained is, however, not merely qualitative but fairly accurately quantitative. For we analyzed very carefully our cosmic-ray curve empirically before we called on any theoretical considerations whatever to explain it, and we reported in scientific papers that our observed curve demanded three cosmic-ray bands of absorption coefficients 0.35, 0.08, and 0.04 per meter of water, respectively.

It was after this work had been done, reported in seminars, written up and prepared for publication in essentially the form in which it will appear², that we set about computing from the foregoing considerations what the theoretical absorption coefficients would be if our observed cosmic rays were produced (1) by the formation in one single act of helium out of hydrogen, (2) by the similar formation of oxygen out of hydrogen, and (3) by the formation

of silicon. But Bowen³ has just identified the last as nitrogen and oxygen, so that these gaseous elements hydrogen, helium, nitrogen and oxygen seem to be extraordinarily widely spread through space.

As to elements found in solids the meteorites have 96 percent of their mass in the four elements, oxygen, magnesium, silicon and iron. Magnesium and silicon are close together in atomic weight, 24 and 28, respectively, so that their formation would constitute but one band, the mean energy of which lies approximately at $\mu = 0.04$. It was this joint band that we above called for convenience the silicon band.

SIMILARLY the atomic weights of nitrogen and oxygen are respectively 14 and 16, and the mean absorption coefficient 0.08 corresponds to this joint band. The helium band, most significant of all, corresponds to $\mu = .30$. There is no other abundant element except iron, and the formation of this out of hydrogen gives a cosmic ray for which $\mu = 0.021$. The existence of such a radiation helps rather than interferes with the fit of our theoretical and experimental curves, but on account of the lack of resolving power in the lower end of our curve it furnishes no trustworthy evidence that



THE REVEALING IONIZATION CURVE

Figure 1: If the spectrum were continuous instead of banded, the curve (of ionization against depth in equivalent meters beneath top of atmosphere) would show no sharp bends

of silicon out of hydrogen. The results of this computation came out 0.30, 0.075, and 0.043, well within the limits of the resolving power of our curve of the observed values.

Further, there are only a few elements so abundant that their formation needs to be considered as the possible source of the observed cosmic rays. For the spectroscopy of the heavens shows a very great abundance everywhere of the gases hydrogen, helium, and ne-

this particular act is the one by which iron is most commonly formed. This uncertainty does not exist, however, with respect to the bands corresponding to $\mu = 0.30$, $\mu = 0.08$, and $\mu = 0.04$.

This whole work constitutes, then, very powerful evidence that the sort of creative, or atom-building, processes discussed above, are continually going on all about us; possibly also even on the earth, and that each such event is broadcast through the heavens in the form of the appropriate cosmic rays.

²Millican and Cameron, Phys. Rev., June, 1928
³Bowen, Astrophys. Jour., 57, 1 (1928)



Photographs courtesy Pictorial California

IN A COACHELLA VALLEY DATE GARDEN

This view through the pleasantly shaded aisles of the garden serves to show the well developed cultural methods that are used. This section is 200 feet below sea-level. An area of 1800 acres is devoted to date palms, with a production of 1,355,000 pounds during the last year

Date Growing in the United States

Old World Planting Stock and American Cultural Methods Are Combined to Produce Large Crops

ALTHOUGH date palms were first planted in the southwest over 150 years ago, the date industry has taken on a commercial aspect only in recent years. The first successful importation of planting stock was made by the United States Department of Agriculture in 1900, and since that time, over 2000 acres of palms have been planted in California and Arizona. The industry centers in the Coachella Valley, a rich irrigated desert section below sea-level in Riverside County, California, where 90 percent of the plantings in the southwest have been made.

From time to time, enthusiastic writers striving for local color have attempted to picture the domestic date industry as an Old World activity transplanted bodily to a new setting. But this is far from true in a practical sense. Although a large proportion of the date palms now producing fruit were imported, the industry is now strictly American, for with the characteristic enterprise of the American pioneer, date growers of California have progressed farther in two decades than their contemporaries in some of the older date-growing countries have

in as many centuries. Since present quarantine laws prohibit further importation of foreign planting stock except for experimental purposes, the two areas are completely divorced.

It is also in the handling of dates for market and the processing and packing of the fruit, that rapid strides have been made in California. Machine methods have been developed in packing house operations and domestic growers have stressed sanitation and attractive packaging. This is the contrast with the practices of the Old World growers who send their product into this country with a rather dubious sanitary history behind it.

THE report of the Riverside County Horticultural Commissioner showed that Coachella Valley marketed 1,355,000 pounds of dates in 1927, which returned growers around 15 cents a pound.

The propagation and culture of dates is a unique and most interesting horticultural operation. Few economic plants have seen such romantic development as has attended the growth of the date industry in the west. Many of the cultural practices

have been evolved in California, although the fundamentals, of course, were brought from the established industries in the East. New methods have not only been developed by the growers themselves, but by the United States Department of Agriculture, which has maintained an experimental station in the Coachella Valley for many years.

Commercial date palms are propagated by means of "offshoots" which sprout from the trunk of the parent palm. The offshoot is really a bud in the axil of the leaf and, therefore, a direct product of the growing stem and of the same variety and characteristics as the mother palm. These offshoots are rooted on the parent palm and later removed with a sharp instrument for orchard or nursery row planting. Each palm will bear from six to 20 offshoots during its production period.



POLLINATION

Instead of depending on natural pollination, date growers use an artificial procedure

With careful handling, offshoots set in orchard form will get a fair start the first year, and production will start during the fourth or fifth season after planting. However, palms do not come into full bearing until they have reached the age of seven or eight years. There is considerable variance in time of maturity among the better varieties of dates. The average production of a palm ten years old is from 100 to 200 pounds.

As the date palm is a dioecious plant, with male and female flowers being borne on different palms, pollination of the female or fruit-producing palm has been a subject of close study. Natural pollination has proved unreliable in commercial production and artificial pollination is practiced exclusively. Both the male and female flowers are borne in large upright clusters enclosed in a spathe, or sheath. This flower cluster is made up of a large number of branches on which the flowers are set. Dates bloom during the period January to April and ripen from August to December 15, although the main harvest season is from September 15 to November 15.

THE common practice of hand pollination on the larger places is to cut a small branch off the male blossom and place it in the female cluster with flowers turned downward. This is done just before or after the protecting spathe breaks open, and when the male blossom has been put in place a slip string is put over the tip of the blossom. The movement of the blossom cluster on the tree will bring about complete pollination.

Other growers take the pollen from the male blossom and apply it directly to the female cluster by several different means. Pollen carefully handled may be kept over from one season to another, and many growers always have some on hand should the male bloom be irregular.

Most growers place paper, burlap or cheesecloth protectors over the clusters as they develop size, to protect

them from rain and sun. This also prevents a certain amount of bird and animal injury. Damage is often reported from coyotes, mules, and other animals. They also seem to like the desert fruit.

Obviously the picking of dates, especially from the older palms, represents quite a problem. A movable platform on which the pickers work has been devised by some growers. The individual fruits are separated from the cluster threads by a slight twisting motion when they are ripe, or nearly so. The fruit of the firmer varieties is placed in shallow boxes holding about 20 pounds and in these containers transported to the packing house. As not all of the fruit matures



PICKING DATES

An elevated platform is provided for the pickers. Here a Mexican laborer is hard at work plucking the ripe fruit

at the same time, it is necessary to go over the palms every few days, and this individual picking of the fruit is quite expensive. In some instances, a bunch of matured fruit will weigh close to 50 pounds and have from 2000 to 3000 dates attached.

At the receiving end of the packing house, each lot of fruit is weighed in, and a grower's name-ticket placed in every box. The fruit is next loaded on trucks and passed into special fu-



DR. A. D. SHAMBLIN

Dr. Shamblin is the date expert stationed at the government gardens in Indio, California

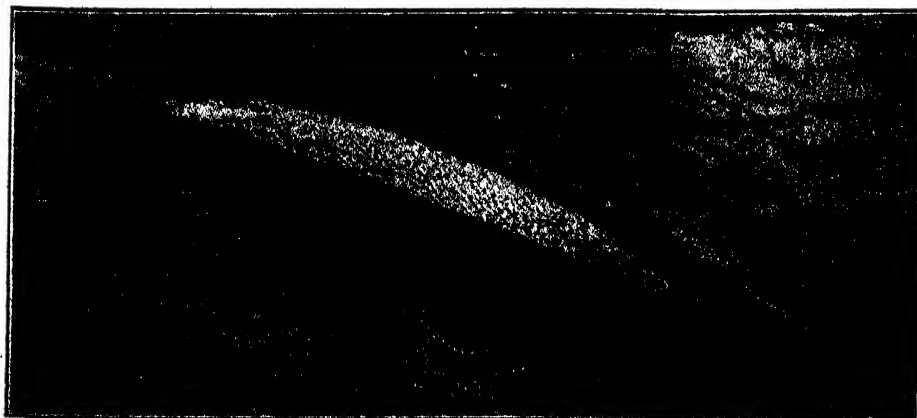
migating tanks, from which the air is then exhausted and carbon bisulfide gas introduced and allowed to remain from one to two hours. The gas is then pumped (being very heavy) or blown out of the tank, which removes the odor from the fruit. Insect life is effectively exterminated by this process.

From the fumigators the boxes of dates go next to the grading room where they are emptied into hoppers and fed through cleaning machines to the sorting tables. Cleaning is accomplished by means of brush and towel devices aided by air suction. Sorting is done by hand from moving belts. The fruit is separated into two or three grades according to quality and a season's pool made of each grade.

FRUIT that is not entirely ripe is spread on shallow, wire-bottomed trays and placed in tight rooms, kept by electric heat at a uniform temperature of 90 to 95 degrees, Fahrenheit, from 24 to 60 hours according to the need. By controlling the moisture content of the air in the rooms, artificial climatic conditions that are favorable to production of quality fruit can be maintained.

Recent experiments in the keeping of dates in cold storage resulted in the erection during the past season of a modern cold storage plant having a capacity of 500,000 pounds of fruit.

The greatest progress in the date industry of California has been made in handling the product for market. Growers realize that the success of their industry depends upon presenting to the American public a product clean and attractively packaged. To this end, growers keep their packing plants scrupulously clean and the progress of the date from the time it is picked until it is placed before the consumer stresses sanitation and freedom from insect infestation.



THE MALE DATE BLOOM

The flower cluster is enclosed within a spathe or hard protecting cover. The cluster is made up of many branches, of which the individual, pollen-laden blossoms are set in whorls

The Plan Is Theoretically Sound

THE editor makes no apology for publishing the accompanying article. It is not a Jules Verne story nor an H. G. Wells story, nor even one of Dr. Hacksaw's secrets. It is a physicist's conception of a method for getting close enough to Mars to see what Mars is really like. The article was first submitted to several laymen for opinion. They voted against it. It was then sent to several physicists. These favored publication. In itself this may have some significance. Mr. Randolph's plan cannot, of course, be realized at present; he says so himself.

The manuscript was submitted to Professor R. H. Goddard, Department of Physics, Clark University, famous for his experiments on high-speed rockets, with the request for a public statement. Professor Goddard replied as follows:

"According to recent press notices, interplanetary transportation must remain impossible until atomic energy can be obtained and controlled. This attitude is, however, much like that of the scientists of 30 years ago, who declared that an airplane could not operate unless the force of gravity could be neutralized.

"If atomic energy were available, it would be a very convenient means of propelling an interplanetary rocket. Atomic energy is not, however, necessary, as an interplanetary flight is possible with means even now at our disposal. This is set forth in my article in the Smithsonian Miscellaneous Collections, for 1919.

"If a propellant of high energy content, such as hydrogen together with oxygen, is used with high efficiency and in the proper way, an interplanetary flight is possible in a rocket that is neither tremendously bulky nor unwieldy. A rocket using a low energy propellant, and operating inefficiently, would, on the other hand, be impractically large.

"The technique of such a flight constitutes a most interesting problem in physics, and is one to which I have given considerable thought for many years. In the light of the conclusions I have reached, I can say that, although Mr. James R. Randolph's article, 'Can We Go to Mars,' may read like romance, it is nevertheless thoroughly scientific, and, while not telling the whole story, it gives a good picture of what an interplanetary rocket must be like."

THE cave man looked across the river and wondered what was on the other side. Before long he learned to build rafts, and later canoes, so that he could go there and see. The Norsemen looked out upon the broad Atlantic and wondered what lay beyond that gray horizon. Presently they built ships in which they could go there and see.

Thus man has spread himself all over the surface of the earth, and within the past generation he has learned to fly through the air as well. And even the bottom of the ocean is yielding up its secrets.

Today man looks through his telescope at the other members of the solar system and wonders what is there. Will he ever be able to go there and see?

Several of these heavenly bodies might repay at least a passing visit, should such a thing prove possible. The Moon is too airless for anything more, but would be interesting to look at more closely than is now possible. Also its invisible back portion would be worth seeing. Venus and the large outer planets hide themselves behind dense veils of cloud, but there is a possibility that Venus might prove habitable for man.

BUT of them all, Mars presents the most interesting possibilities, and would probably be the first visited. Its skies are generally clear, permitting an easy view of the surface, and this surface appears to resemble our own in some respects, although in others it is very different. There is a possibility that men might be able to live there,

although scientists are far from agreement on this question.

And over all this surface is a network of fine dark lines, the "canals" of Mars, which many people believe are the work of beings having intelligence comparable to our own. None of the other theories advanced to explain them have proved satisfactory, at least in the case of certain of these canals. Even a flying visit might settle this question beyond a reasonable doubt, and would show whether or not there really are "people" there.

THE space between the two planets is devoid of air, or any other kind of matter. Hence, there is only one way in which such a trip could be made. A projectile of some sort would have to be thrown off from the earth with sufficient velocity to clear the earth's attraction, and would then have to be directed into an orbit that would touch the orbit of Mars at the time Mars got to that particular part of it. Then, its velocity would have to be reduced so that it could be captured by the planet and become a satellite. Such it would remain for about a year, at the end of which time its speed would have to be increased, returning it to its own orbit, and thence back to the earth.

Thus the projectile would have to be able to change its velocity in a vacuum, and at the start it would have to attain a velocity of seven miles per second, as that is the velocity needed to escape the earth's attraction.

There is only one device known to science at the present time with which

Can

A Physicist's Solution of

these requirements could be met. That is the high-altitude rocket invented by Professor Robert H. Goddard of Clark University. The shells from the largest naval guns have a muzzle velocity of little more than half a mile per second.

The Goddard rocket is now in a stage of development corresponding to the small airplanes built by Langley. Small rockets have been built to test the principle that would be employed in constructing one to reach very high altitudes. The theory has been proved sound, and it has been shown that the problems to be encountered in going from these to large rockets capable of infinite range are no more serious than those involved in the design of huge transatlantic liners. Engineering difficulties may be looked for because of the enormous size of the machine, and the cost will be very great, but the plan is by no means impossible.

STRANGE as it may at first seem, the Goddard rocket, or any rocket, for that matter, works just as well in a vacuum as in the air. In fact it may work even a little better. So the rocket would not have to come up to full speed while in the air, and the changes of speed required after leaving the air entirely behind could readily be made.

This fact has been proved by experiment. It can be readily understood, however, when the principle on which the rocket works is understood. This is the law known as Newton's Third Law of Motion, and states that *to every action there is an equal and opposite reaction*.

For example, if you are standing in an unmoored boat, and walk toward the shore, the boat will drift away from the shore. The air has nothing to do with this. In order to start your body forward you have had to give it a push. This push, acting backward just as much as it does forward, causes the boat to move in the opposite direction.

Again, when the powder explodes in a gun, its pressure drives the bullet forward. But this pressure acts backward on the gun as well as forward on the bullet, and causes the "kick" of the gun. In a rocket there is no bullet, but the gases are expelled downward with high velocity, and the "kick" drives the rocket up at rates of acceleration which could be nicely controlled.

The Goddard rocket differs from the

We Go To Mars?

Approach to a Fascinating Problem, the Which Is, However, Far Away

By JAMES R. RANDOLPH

ordinary rocket, much as a modern turbine differs from a hurdy-gurdy, or flutter wheel. It works on the same principle, but it has been designed for the highest possible efficiency and power output. Some of the latest rockets use liquid fuel whose nature is being kept secret, but the earlier ones used smokeless powder.

In these rockets the powder is confined in a strong steel chamber capable of resisting the pressure of the explosion, and the gases are ejected at the lower end through the expanding nozzle. This nozzle resembles those used in steam turbines, and is designed to give the highest possible velocity to the gas. In some experiments using smokeless powder, this velocity was found to be 8000 feet per second; while more recent tests indicate that velocities as high as 12,000 feet per second can be obtained.

The velocity given to the rocket as the gas shoots out can be calculated by the momentum equation of elementary physics. This shows that a pound of gas coming out at 8000 feet per second would give a 100-pound rocket an increase of velocity of 80 feet per second. ($8000 \times 1 = 80 \times 100$)

The next pound of gas ejected will increase the rocket's velocity by a somewhat greater amount, for the rocket weighs less by the weight of the ejected material; and this process can be kept up indefinitely. Strange as it may seem, the rocket can be made to go a great deal faster than 8000 feet per second, for the momentum equation is not in the least concerned with the absolute velocity of the bodies. It affects only their relative velocity.

BUT as the final velocity of the rocket is increased the amount of powder required goes up enormously. If the final velocity were 3.5 miles per second there would have to be at least 20 pounds of powder for every pound of rocket left at the end of the firing period. If the velocity is to be twice as great, or seven miles per second, the weight of powder will not be twice 20, but will be 20 squared, or 400 pounds.

Consequently, these high-altitude rockets are to be made in several sections, so that the chambers carrying the powder charge can be thrown off as fast as they are emptied, retaining only full ones which give the

rapidly increasing velocity. Magazine rockets have also been tried, in which the propellant is not put into the pressure vessel until it is to be fired.

Such a rocket could be made in two sections. After the powder charge in the larger rocket has been burned, the casing would be discarded and the smaller rocket would go on alone. This process may be repeated any number of times.

A very large rocket, capable of leaving the earth, and of carrying men, would involve serious engineering problems. The same is true of any structure. A bridge across a small mountain stream is easy to design. One across the Hudson River at New York is very difficult. The same is true of large steamers, large airplanes, and large rockets.

A FEW examples will give an idea of what this difficulty is. A brick pier a few feet high would support a weight of 4000 pounds for each square inch of its surface. But a pier a mile high weighs more than 4000 pounds per square inch of horizontal section. Hence it would break of its own weight, unless spread out like a mountain to give a broader base. Five miles of steel wire form a heavier weight than the wire itself can support. And as these limiting weights are approached, the proportion of structure to useful load increases, and the skill required in design becomes greater, in order to keep this proportion down.

In a rocket, all loads would be greatly increased by the rapid acceleration at the start, but this could be calculated in advance and allowed for. Acceleration in a rocket like this is under perfect control. The numerous small charges are fired by a time clock, and at any rate desired. Even in the simpler rockets, like Goddard's present forms, there are ways of controlling this, as by making the grains of the powder small or large. The smaller the grains the faster the powder burns. But in an actual trip the acceleration should be made just

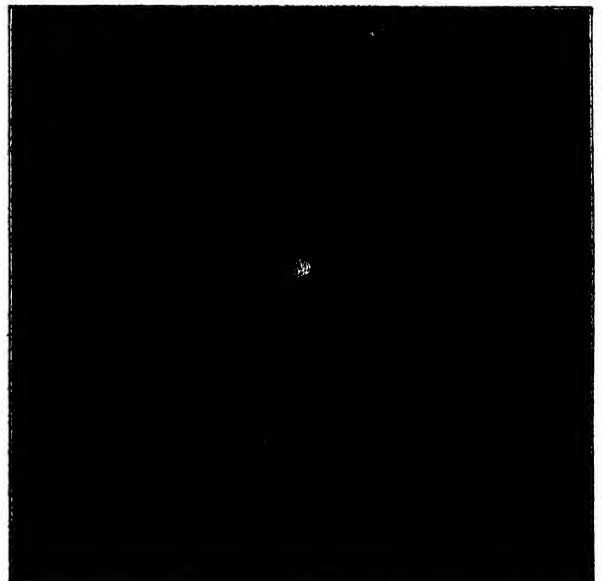
as great as the passengers could stand. This would be tried out beforehand, possibly in a rapidly revolving drum, and the start of the rocket governed accordingly.

A suggested design is shown for the head of a rocket to go to Mars. This gives some idea of the problems that would have to be met in such a structure. Only the top part of the main propelling charge is shown. It is divided among several thousand cylindrical containers, each with a separate nozzle. These are burned in order, beginning at the bottom, and are so proportioned that the charge in each is burned out before there is time for the heat to damage the nozzle. Then the container is dropped, and the one above it comes into play. The walls of the containers awaiting their turn, and hence not under pressure, are counted on to furnish the strength required to support the weight above them.

ABOVE the cabin, and just below it, are shown the powder charges used to slow the rocket down when reaching Mars, for speeding it up to get away again, and for slowing down on reaching Earth. Above and below the cabin are two special jets for making small and controllable changes in the rocket's velocity. The regular containers make changes of definite size.

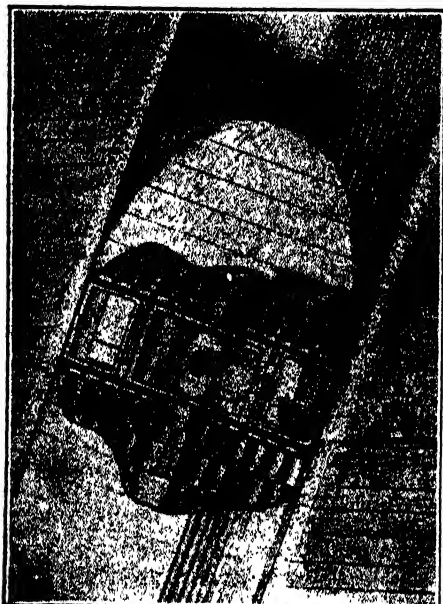
In the cabin structure is a central chamber in which are shown several tanks for the fuel required by these special jets; a pair of gyroscopes to hold the rocket on its course (these are in the spherical ended shell at the center); and at the right the switchboard through which the firing charges are governed.

This chamber is occupied only when starting or changing speed. There would be no people in it during flight.



ORBIT OF EARTH-MARS ROCKET

The earth is shown in position at the start; Mars at time of arrival, seven months later. Round trip, say, two years

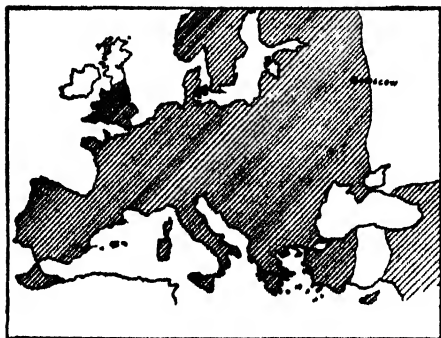


MARS ROCKET—AUTHOR'S DESIGN

It starts from a shaft in the earth, but by means of its own propellant—no explosion

Around the outside are the passenger quarters, and when in flight these rotate about the central chamber. This creates a centrifugal force that takes the place of gravitation, and holds the people against the outside wall, which then becomes the floor. This provision is essential to the comfort of the passengers. Once the push of the jets had stopped, no action of gravitation would be felt. Man is not adjusted to this condition, and would probably get very seasick. Also, any liquids or small objects that were spilled would float around in the air indefinitely.

THIS rocket, when clear of the Earth, would be given an added velocity of about two miles per second in the direction in which the Earth is moving with a velocity of 18.5 miles per second. This would throw it into a much more elliptical orbit, which would bring it to the orbit of Mars about seven months later. Departure would be so timed that Mars would be there when it arrived. It would then be slowed down until it became a satellite of Mars, which it would remain for about a year. Then, the positions of



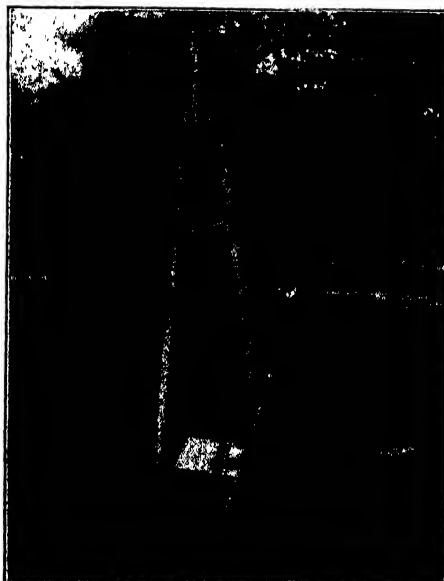
ROCKETS AND WARFARE

Shaded areas are within 300 miles of foreign frontiers, and subject to air raids. Rockets would make this aerial danger worldwide

the planets being suitable, it would be speeded up and brought back to Earth.

A large and heavy mass like this, approaching the Earth at seven miles per second, could not be safely landed. Hence it would be abandoned when near the air, and the occupants would come down in the landing plane, shown on the right near the door. This is a small air tight glider, with folding wings, and having a special door to permit its release.

A rocket such as this would weigh as much as an ocean liner, but would probably be easier to design, as the structure is more compact and the forces more definitely known. But its accommodations would be severely limited, as food, water, and even oxygen



READY FOR A TEST

Professor Goddard and a small experimental rocket (in the tube which is open at bottom)

for the entire journey of over two years would have to be taken along.

Because of its high cost, and the lack of a financial motive for the trip, it is likely to be a long time before such large rockets are built.

The Goddard rocket in its present size could be used for exploring the upper atmosphere, beyond the range of sounding balloons. The next development that is planned is the study of the Heaviside layer, which is supposed to exist at an altitude of about 60 miles above the Earth's surface, and to play an important part in the transmission of radio signals.

It is also planned to take astronomical photographs from outside the Earth's atmosphere.

A further development of the Goddard type of rocket is likely to be that for war. Experiments along this line were begun during the World War, but were dropped when the armistice was signed. At that time they had resulted in a multiple-charge rocket that fired several charges in succession, and

traveled straight. It was shown that these rockets could be made at least as accurate as a long range gun, with vastly greater possibilities as to size and range.

Rockets are possible that could shoot half way around the Earth, carrying loads of hundreds of tons—and this offers interesting possibilities for the next war. They could be steered to a limited extent, the pilot staying in the rocket until the last possible moment, and then going off in a landing plane.

Decided changes in world politics would follow the introduction of such a weapon. The armored horseman brought in the feudal system. The gun restored democracy. The modern battleship suppressed piracy, and abolished the rights of small nations. The airplane made the League of Nations a necessity by bringing possible enemies entirely too close for comfort. The rocket would bring America and Russia as close together, in a military sense, as France and Germany now are.

IN the right hands the rocket would bring universal peace. In the wrong hands it would lead to conquest more absolute than anything the world has ever known. The largest empires of past and present could not exist without great numbers of loyal soldiers to hold them together. An empire using rockets would need only governors and spies. The mechanics who made the rockets could be slaves, and a mere handful of men could direct them.



TESTED IN A VACUUM

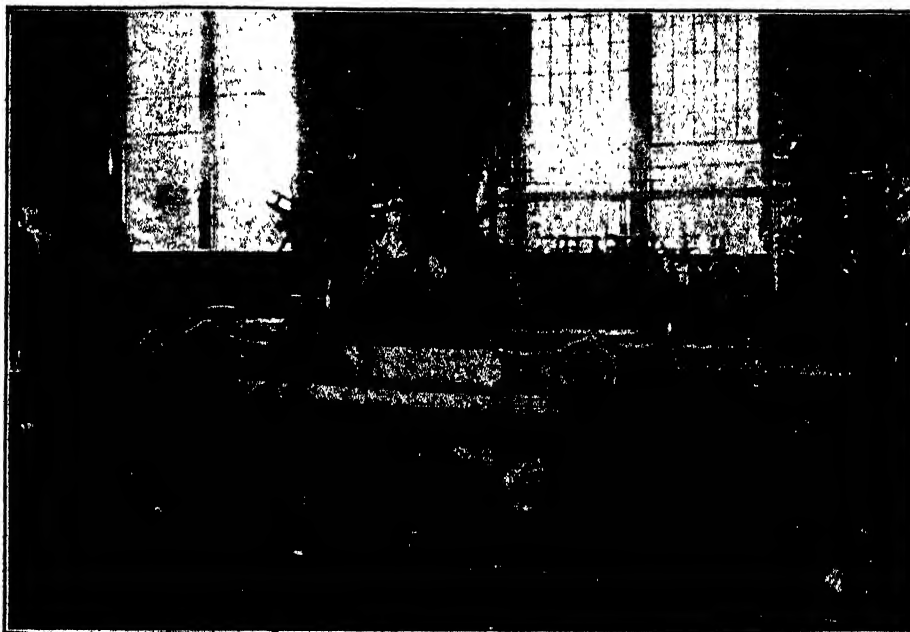
Rocket is in the straight part. Loop keeps the gases from affecting it. The rocket worked

Burning Steel to Form Machine Parts

PRIMITIVE peoples fashioned their dugouts by burning the "core" out of a solid log, thus forming a shell. Today the same principle of burning is being applied to the manufacture of products, not from highly combustible material, but from rolled steel. Huge locomotive main and side rods, large nut blanks, gears, wrenches, and a great variety of other parts are being cut out in this manner.

In this process, which has been developed to a high degree of perfection during the past few years, the part to be burned or, more properly, cut, is preheated to a white heat by a jet flame in which hydrogen, natural or oil gases, or even city gas may be used. A jet of pure oxygen is then played on the metal, causing it to ignite and burn, combustion being nothing more than a rapid form of oxidation. No practical work is done by the preheating flame, however.

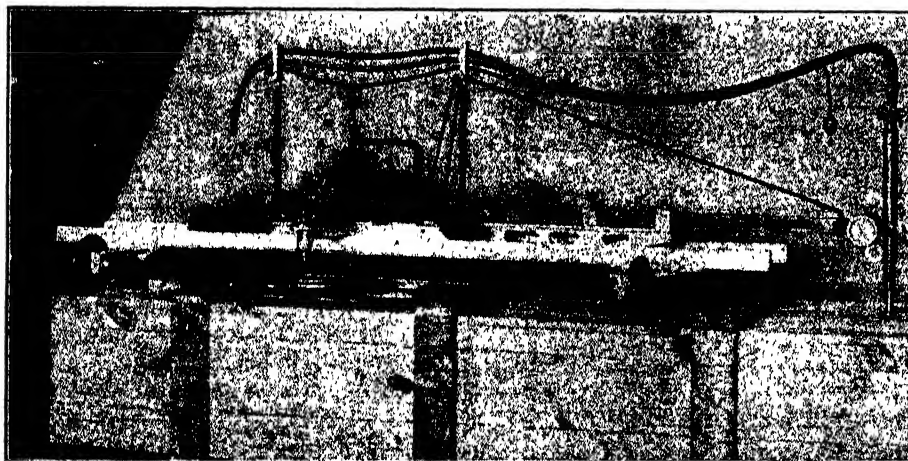
High-pressure oxygen, drawn from a tank and expanded to working pressure, cools rapidly so it is necessary in



Photographs courtesy General Welding and Equipment Company

AUTOMATIC SHAPE CUTTING MACHINE FOR RAILROAD SHOP

On this machine a locomotive side rod can be cut in from 15 to 20 minutes. One has just been cut and stands upright to show cut faces. Another billet is laid out beside this ready for cutting

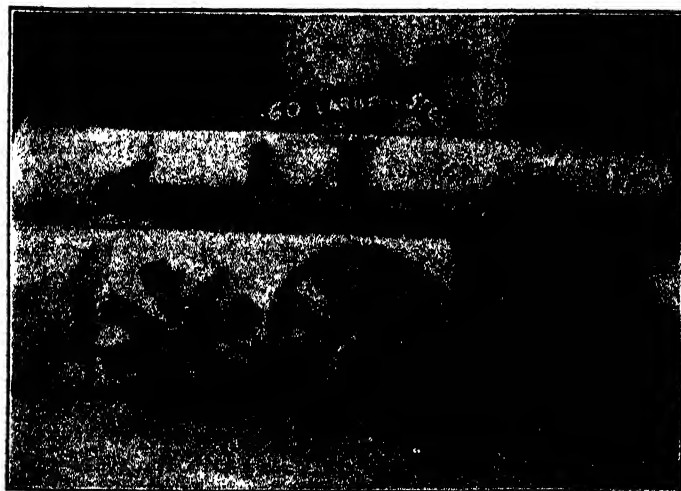


DETAIL OF SHAPE CUTTING MACHINE

The working mechanism of the machine, without bed, showing the double carriage system and the template which governs correct movement of the torch without assistance from the operator

this process also to pre-heat the oxygen. This is sometimes done by the use of hot air, hot water, or steam heating devices. For average cutting, the oxygen may be warmed by passage through the preheating flames at the nozzle.

Rolled steel has greater strength and ductility than either cast iron or cast steel, and is much cheaper. In using it to replace such castings, there are the advantages of lower weight which lowers transportation costs, lower cost of metal, higher quality, and less breakage. Add to this the fact that it is necessary to keep in stock only regular rolled material and no great quantity and variety of cast shapes nor great number of costly patterns, and the many other advantages of this process may readily be seen.



SAMPLE CUTS

Here it will be seen that the edge of oxygen-cut material is almost as clean as if it had been punched, an operation obviously impossible



MORE SAMPLES

In cutting such parts, all the operator has to do is to watch the torch, start and stop the machine which steers itself, and adjust the speed

Three Centuries of Natural Philosophy*

*During Many Barren Centuries, Science Crept. Its Recent
and Rapid Advances Have Nearly All Pivoted
On the Genius of a Few Individuals*

By W. F. G. SWANN, D.Sc.

Director, Bartol Research Foundation of The Franklin Institute

THREE thousand years ago there died in Egypt a king. He was buried with much pomp and ceremony, and in the company of such material things as reflected the atmosphere of his time.

After thirty centuries, untouched except for the minor vandalism of robbers, these relics speak to us the story of an age which has passed. They tell us of a skill in craftsmanship equal to our own, of a beauty in art and in concept of design such as wins the admiration of our most famous artists; and reading the evidence of a little act here and a little thought there, we begin to see a people such as we could well have known as friends—a people of whom who can say that if one of them were born today and raised with our children he would be distinguishable from one of us?

YET, neither in the age that knew Tutankhamun, nor in any of the ancient civilizations that have gone before or after, do we find any shadow of a concept of that great scheme of nature's laws which has unfolded itself so unsparingly in our generation.

If the period from the dawn of history to the present time be shrunk into a day, we shall find that twenty-three hours of that day are barren as far as natural philosophy is concerned, for it is only in the last hour that science was born; and, even as the human child develops in its struggles toward manhood, so this child of nature has grown, but with such ever-increasing strength that in the last ten minutes of its existence, in the last twenty-five years of actual time, it has outshone all the accomplishments of its infancy and adolescence and has torn from nature more of her secrets than she has vouchsafed to man in the whole previous history of his existence.

Three hundred years ago we find the

world just emerging from the state in which he who would search for the hidden truths of nature must contend with three great obstacles—superstition, the power of the church, and, last but not least, a conglomeration of fixed notions as to the way things should happen, built upon the pseudo-philosophical reasoning of bygone ages, reasoning founded not upon experimental bases, but upon dogma evolved out of the imaginations of the philosophers.

The train of scientific thought was founded largely upon the hypothesis

composed are solids, and therefore have three dimensions. Now three is the most perfect number; for, of one we do not speak as a number, of two we say both; but three is the first number of which we say all. Moreover, it has a beginning, a middle, and an end."

Towards the end of the fifteenth century we find young Galileo enjoying the princely stipend of fifteen cents a day as professor of mathematics at the University of Pisa. It is true that the professor of medicine gets thirty times as much, and Galileo's parents had

originally intended him to be a professor of medicine. But what does he care! For he is much interested in discovering the laws of falling bodies; and, in spite of the fact that Aristotle has said otherwise, he is contending that heavy bodies and light bodies fall at the same rate. In scientific circles much resentment is felt at such a revolutionary suggestion; for Aristotle, without appeal to experiment, has evolved out of the consciousness of his inner mind the decision that bodies fall at rates depending upon their weights.

IT matters not that young Galileo has ascended the leaning tower of Pisa with a one-pound weight and a hundred-pound weight and, in full view of the learned men of the day, has dropped them from the tower and found that they struck the ground together. For Aristotle has maintained otherwise, and science is the voice of Aristotle.

Neither is there more tolerance in the matter of astronomy. For Galileo has invented and constructed a telescope; and although he has received much honor from his university for this performance, and has had his salary doubled, there are many who not only refuse to accept what the telescope reveals, but steadfastly refuse to look through it lest they should be convinced of the truth of that which they do not wish to believe. With this



NEWTON—BEST INTELLECT

Few would dispute the claim that the profundity of Newton's intellect has never been equalled in any age

that the writings of Aristotle were to be the ultimate court of appeal in all matters of dispute, and wondrous indeed were some of the things which Aristotle and his disciples had said. A good example of some of their misty philosophizing is the proof given by one of them that the world is perfect.

"The bodies of which the world is

*Founders' Day Address, Swarthmore College. From *Journal of The Franklin Institute*

obnoxious machine Galileo has found that the moon has mountains like the earth, which robs that body of some of its individual importance. He has found spots upon that most perfect of heavenly bodies, the sun, but worst of all he says that Jupiter has four moons attendant upon him. This last conclusion is in a way to upset everything.

Although too much of a man of progress to doubt the evidence of his own eyes, even the great Kepler is disturbed in his mind. For, according to all prevailing notions of the day, there should be seven planetary bodies and no more—the earth, moon, Mercury, Venus, Mars, Jupiter and Saturn.

Hear the argument of Francesco Sizzi, himself a Florentine astronomer, against this assertion of Galileo:

THERE are seven windows in the head, two nostrils, two eyes, two ears, and a mouth; so, in the heavens there are two favorable stars, two unpropitious, two luminaries, and Mercury alone undecided and indifferent. From which, and many other similar phenomena of nature, such as the seven metals, etc., which it were tedious to enumerate, we gather that the number of planets is necessarily seven.

"Moreover, the satellites are invisible to the naked eye, and therefore can have no influence on the earth, and therefore are useless, and therefore do not exist.

"Besides, the Jews and other ancient nations as well as modern Europeans have adopted the division of the week into seven days, and have named them from the seven planets; now if we increase the number of planets this whole system falls to the ground."

You can judge of the wrath and indignation which Galileo brought upon his head when he contended in reply

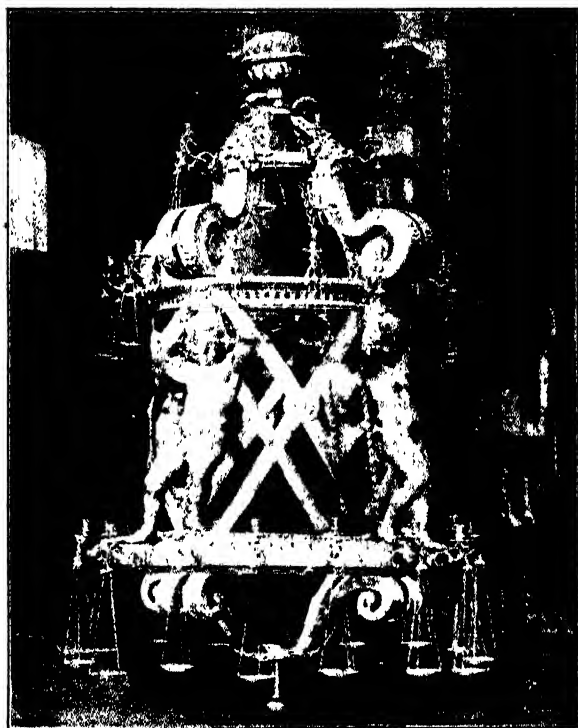
¹Quoted from Sir Oliver Lodge's "Pioneers of Science."

that, whatever might be the force of these arguments as a reason for believing beforehand that no more than seven planets would be discovered, they hardly seemed of sufficient weight to destroy the new ones when seen.

It was Galileo who wrested from nature the secret of the laws which govern motion—the laws which govern the motions of almost everything, the planets in the heavens, the fly wheel of the steam engine, the bird in flight—yes, and in a large measure at any rate, the motions of the innermost parts of the very atoms of matter itself. But Galileo did not evolve these laws out of the dogmas of imagination, but by the more humble and safe appeal to direct experiment. He marked out the method of approach, the experimental method, which has been the model for all succeeding generations in their search for the fundamental facts which govern the workings of nature.

THE laws of motion may be written on a postcard, but their consequences have not been exhausted in all the books men of science have written in three hundred years. As we all know, Galileo's life was beset with tribulation. He lived in an age when there was little tolerance for one who followed not the conventionalities of thought of the day. To question the learning of the past was arrogance, to discover new truth was blasphemy, and so he died having sown, however, the seeds of the fruit that was to come. He died in a world seething with superstition and ruled by the dogmas of an ancient past, but a world which was destined only a year later to see the birth of one who is rated by many as the greatest genius of all time—that great prince of England's men of science—Isaac Newton.

In its purest aspect, the task of the natural philosopher to-day is to discover the relationships existing between the different phenomena which happen in our universe. He seeks to see in the workings of nature simply different illustrations of a few fundamental principles. Newton was the greatest of the pioneers in this method of systematized thought. In his great work,



FAMOUS SWINGING LAMP

Was it a dull sermon that diverted the youthful Galileo to the epochal discovery of the laws of the pendulum?

the "Principia," characterized by the Marquis Laplace as pre-eminent above all productions of the human intellect, he demonstrated the powerful simplicity of the fundamentals which control the destinies of the heavens. No longer did the universe appear as a bizarre and formless thing governed by such a heterogeneous system of agencies as to merit well the caustic comment of the sovereign of Castille when, bewailing the complexities involved in an attempt to explain the motions of the planets, he remarked that "Were the heavens thus constituted, he could have given the Diety good advice."

No longer need the sun carry spokes, as Kepler thought, to grind the planets around in the heavens. No longer was a guardian angel necessary for each planet to guide its course. No longer were the planets whirled through space by the whirlpools of an ether as a twig is whirled about in the rapids.

ALL that was necessary was the laws of motion of Galileo, operating under the influence of a force emanating from the sun according to the inverse square of the distance therefrom. And this force was no new and mysterious thing, for Newton showed that gravitation, that same old force which had been known for so long—gravitation which causes apples to fall from the tree to the ground—was sufficient to control the moon in its orbit, and such a gravitation with its origin in the sun served the purpose of controlling the planetary motions. Moreover, in this same gravitation did the tides find their origin through an

Putting the aphelion velocity of Saturn equal to G, the lowest tone of the earth will also be G, because the two tones are represented by the figures 1'46" and 1'47", practically identical, but it will be G treble, five octaves higher. The figure for the highest tone of Mercury is 3'0", very nearly $\frac{1}{4}$ of 1'47", the tone is E⁵, seven octaves and a major sixth above the lowest tone of Saturn. The tunes played by the planets are therefore¹:



From Dwyer, "History of the Planetary Systems"

THE MUSIC OF THE SPHERES

Early science was burdened with much nonsense of this kind. It has not all departed from the world, even yet



GALILEO IMPRISONED

Galileo was not notably tactful, but the stubborn dogmatic ignorance of his age must have been maddening to him

attraction of the moon. In this same gravitation from the sun, combined with the flattened shape of the earth, did that mysterious conical motion of the earth's axis concerned with the precession of the equinoxes find its origin, and in the laws of Galileo was to be found an explanation of the actual flattening of the earth's shapes as a result of the centrifugal force of its rotation.

These and many other things did Newton demonstrate in the "Principia" and by their means brought astronomy from a state of pure charlatanry to the state of order symbolized by Pope's famous words, "Nature and Nature's laws lay hid in night, God said: 'Let Newton be' and all was light."

EVEN as our greatest architects strive for beauty couched in a fundamental simplicity of design, so the Grand Architect of the universe revealed himself in Newton's great work as the father of the principle of dignity of structure through ultimate simplicity. It is a great faith in the possibility of seeing in the operations of nature the working of principles which are ultimately simple which, as each new discovery is revealed, has encouraged man to the hope that he may some day understand them.

While to-day nature has revealed many treasures unknown to Newton, there are few who, realizing the great stride made in the "Principia," will not to-day join with Halley in his eulogy of that great work, "So near the gods man cannot nearer go."

When an outstanding genius causes science to take a leap forward beyond the vision of his contemporaries, there

usually follows a period of depression in which it seems that all that is worth doing has been done, and that what the universe has not already revealed must forever defy the power of man to fathom. Such a period followed Newton. Of course, much valuable work was done in the years which came after, but it took more the form of a development of the consequences of Newton's labors than of the discovery of new paths of knowledge. And then, only about a century ago, a new page in the architectural designs of the universe was turned, and the heading on that page was *electricity*.

The forerunners in the march of science do not often come heralded by much ceremony suggestive of the power that lies behind them. Often in apparent trivialities do they reveal themselves — trivialities so void of spectacular content that but few can be found who deem it worth while to listen to their story.

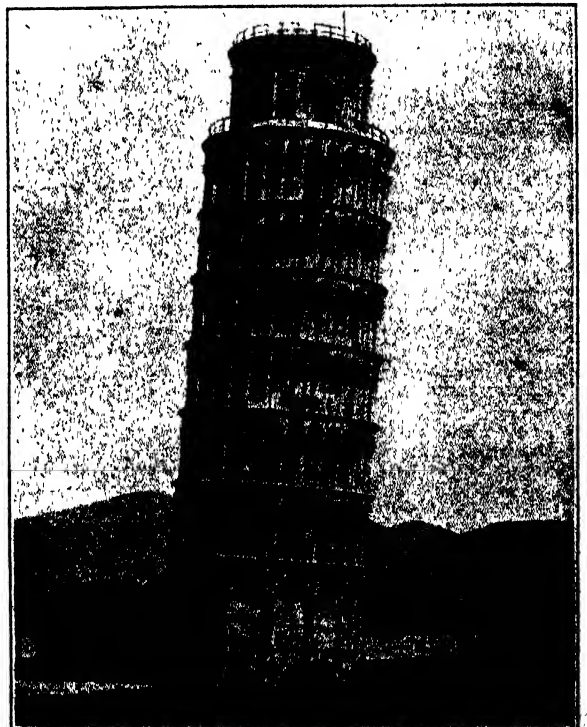
A HUNDRED and fifty years ago a little more was known of the science of electricity than the fact that if a black rod is rubbed with the skin of a cat it will acquire the power to pick up small pieces of paper, and, if viewed in the dark, will be found to emit a blue glow. One can hardly imagine a set of phenomena more vulnerable to the scoffer; for, black rods and cats have been the stock paraphernalia of witches from time immemorial — the blue light visible in the dark adds no particular prestige to the phenomena. And then, we find that these things will not reveal themselves in the presence of water. Now, we should say that water destroys the electrical insulation, but the scoffer who had heard so much of the fundamentality of that triumvirate, "earth, fire and water," might find ample wherewithal to whet his sarcasm, and even though he should admit the reality of the phenomena themselves, he might well attack them on the basis of their futility, for it would appear that if all the black rods in the world were rubbed with the skins of all the cats, the most that might hope to be accomplished

would seem to be the raising of a small weight of totally insignificant amount. And yet, on this earth at that very time there existed, and within the reach of man, the wherewithal to make a dynamo.

To one who contemplates the enormous manifestations of electrical power today, it seems almost inconceivable that all of these potentialities could have remained dormant for the whole period of man's civilization.

The Royal Institution of Great Britain was founded by Count Rumford in 1799. Its stated purpose is "the promotion, diffusion, and extension of Science, and of useful knowledge." To its lectures given by Sir Humphry Davy at the beginning of the last century came a young bookbinder's apprentice, whose enthusiasm sufficiently impressed the lecturer to result in his being appointed as assistant at the Institution.

UNFORTUNATELY, it became necessary for the young man to have some money wherewith to live, but there was no money for scientific assistants. However, the Institution had an appropriation for janitors and so the bookbinder's apprentice, Michael Faraday, became janitor at the Royal Institution. I do not know how efficiently he performed his duties in the office of janitor, but even though he may have neglected the windows of the laboratory, he cleaned well the windows of science, and even though he may have neglected the cobwebs on the walls of the building, he cleaned many of them from the horizon of knowledge.



GALILEO'S REAL MONUMENT

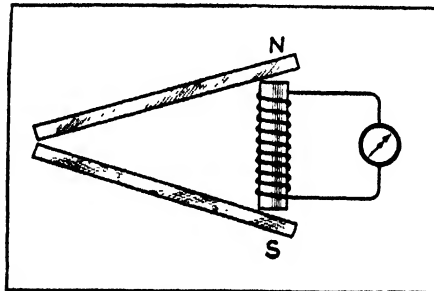
Here he demonstrated the action of falling bodies. Observers consulted their Aristotle, and "proved" Galileo's "error!"

The fact that wires carrying currents possessed in many respects the characteristics of magnets was already known, but it fell to Faraday to discover the fact that batteries were not the only means by which electric current could be produced, and to demonstrate the fundamental principles upon which electrical engineering is based today. By the labors of that little group of men, Ampère in France, Faraday in England and Henry in this country, we came into possession of most of the facts governing the broader features of electrical science, of the facts which tell us how to build a dynamo, a motor, and the like. We came to know of strange new forces with mysterious relations between them. But what was their explanation—what was the secret of their mutual relations—of what broad principles of the design of the universe did they form a part? Then came Clerk-Maxwell who sought to correlate these discoveries into a harmonious unity.

MAXWELL was a great mathematician; and, as a result of his labors, he wrote a book which few could read, but which, in the years that have followed, has served to mould our thoughts to that comprehension of the subject which we enjoy today.

The place of the mathematician, of the dreamer, in natural philosophy, is not always apparent to the layman. He takes the facts which the experimenter gives him, and seeks to correlate them as part of a greater framework of truth in the hope that the frame itself shall suggest other things which may be true, and thus stimulate further search, and widen our comprehension of the whole. A man coming to us from another country, or from another world might, by observing the actions of our President, our Secretary of Labor and the governor of one of our states, form some sort of an opinion as to the probable actions of these individuals under given circumstances. His understanding of the whole situation would, however, be much less complete than

it would be were he acquainted with the whole mechanism of our constitution, or even with some part of it which was fairly complete in itself. If his knowledge is confined within the limits we have supposed, however, he might take such information as he had, and try to reduce it to some sort of order by building in his mind a constitution of which such individuals as he knew

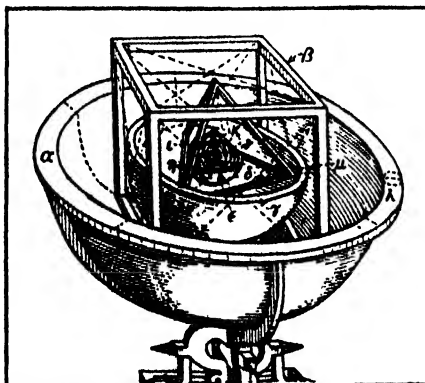


FARADAY'S EXPERIMENT

When the coil was moved between the magnets, a current flowed—the first dynamo!

formed a part. In this creation of his mind, he would have to picture many new individuals and offices in order to complete the framework of his thought. He would naturally suggest a search for these individuals. Every additional one found would add more certainty to his general plan, while every one he failed to find would give him a clue as to how his plan should be modified in order to conform to the facts.

When all was complete, or, indeed, long before all was complete, long before he knew the status of every minor clerk in the government's employ, he would be conscious of a much better understanding of the whole situation,

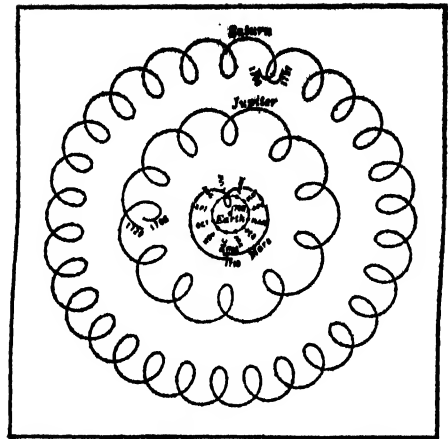


From Dunstan's Astronomy, by permission

AS KEPLER SAW IT

By spheres, cubes, tetrahedrons and dodecahedrons, he explained the orbits of the planets

and would be in a much better position to draw upon the services of the government than he was when the whole of his knowledge was confined to the actions of the three individuals we named at the start. If this man, who corresponds to our mathematical physicist, should now go back to his own people he would doubtless have much difficulty in making them understand the plan of our government. The facts they would have to accept, but it might



From Proctor's Old and New Astronomy

PTOLEMAIC SYSTEM

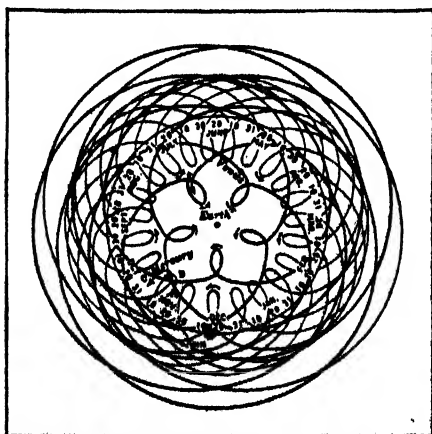
How the biblical school of astronomers accounted for the motions of the outside planets

be only after prolonged experience of our actions that the mechanism of our procedure would enter into their inner consciousness with that force which implies understanding.

So, Maxwell sought and found a beautiful scheme of thought in which to comprehend and harmonize the discoveries of his predecessors. The form of his scheme was such as to suggest that it should be possible to propagate electromagnetic disturbances in the form of waves in an all-pervading medium, and that certain of these waves should have the properties of light waves, and that all should travel with a velocity equal to that of light.

HIS conclusions in the latter respects were beautifully verified by his calculation of the correct velocity of light from purely electrical data, and his predictions in the former have received wonderful justification, first in the experimental work of Hertz and Lodge, and finally in the modern developments of wireless telegraphy and telephony in the hands of Marconi and others, developments which at every stage of their progress have drawn upon the principles outlined in Maxwell's great work. We now know that the electromagnetic waves of wireless, heat rays, light rays, the ultra-violet rays used therapeutically, X rays, the gamma rays emitted by radium and the cosmic rays of which we have heard so much recently, are all special cases of electromagnetic waves differing from each other in their essentials only as regards their length. The longest are the wireless waves, which attain lengths of the order of a mile, and the shortest constitute the cosmic rays, whose length is comparable with the millionth of a millionth of a centimeter.

And then, following Maxwell, once again science made one of those pauses for breath in which many seem to see the end of all that man may hope to know—those dread pauses in which the horizon of discovery seems the boundary thereof. (Concluded next month.)



From Proctor's Old and New Astronomy

THE INNER PLANETS

At all costs the earth must be retained as the hub of the universe! Hence this maze



All Photographs Courtesy Metals Protection Company

TREATMENT TANKS, NICKEL AND CHROMIUM PLATING BATHS

The hoist crane lowers the work into the treatment tank in the rear, then brings it forward through cleaning, nickel plating, treatment, and cleaning tanks to the chromium plating tank in front

Enter Chromium Plating Process Is Successful After Years of Study and Perfection of New Treatment

THAT pocket lighter you bought some time ago—perhaps you have wondered what metal was used to plate it and give it its beautiful silvery surface. You realized that if platinum had been used, it would have been so marked; and the surface was harder and more lustrous than nickel. More than likely it was plated with chromium, for many pocket-lighter manufacturers, as well as manufacturers of other plated products, have taken advantage of the superiority of this metal over other plating metals and have adopted it as a finish for their products.

Within recent years, great strides have been made in the perfection of the chromium plating process. Almost 75 years have elapsed since Bunsen first

obtained metallic chromium by electrolysis of chromic acid, but it is only since the World War that the conditions necessary for obtaining a satisfactory commercial coating of the metal have been worked out. The process is one requiring far more study, experimentation, and research than that of commercial plating with any other metal now generally used.

An electroplating bath for chromium known as the "acid" bath, was worked out by Carveth and Curry in 1905; a "neutral" bath was worked out in 1920 by Sargent, this being essentially the same as that generally used at the present time; and the "basic" bath was developed from Sargent's "neutral" bath by the addition of a small amount of chromium chromate. These three

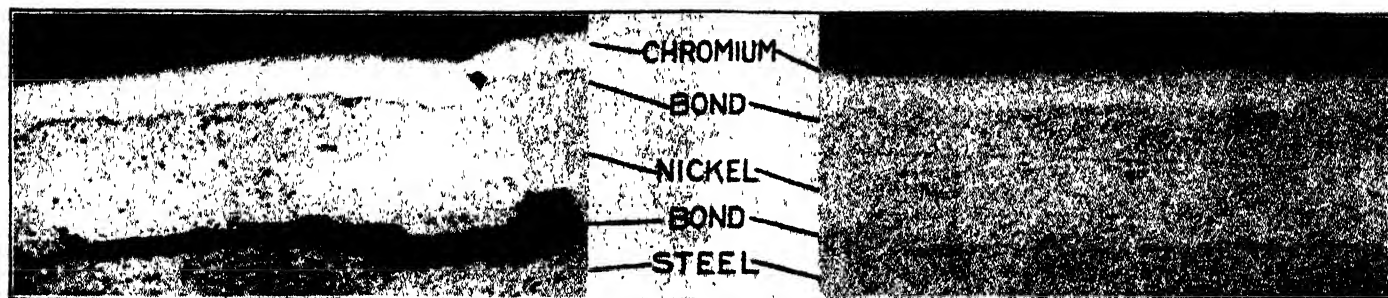
baths are identical, not only in behavior, but in ultimate composition. Technological Paper Number 846 of the United States Bureau of Standards concludes that "the recent industrial success of chromium plating must, therefore, be attributed not to any improvement which has been made in the bath, but to its more careful operation and control."

Metallic chromium ranks next to the diamond in hardness and it is many times harder than the best steel. It possesses high resistance to corrosive and tarnishing influences such as all alkalies, oxygen, chlorine up to 300 degrees Centigrade, sulfur, superheated steam, and concentrated nitric and sulfuric acids. It is too brittle to be used alone, but alloyed with steel, it has become familiar to everyone in stainless steel cutlery. These qualities, together with its platinum-like finish and high polish, make it a valuable plating metal.

IT is now being applied to such widely different articles as plumbing fixtures; watch cases; automobile bumpers, trim, et cetera; surgical instruments; and machine spindles and parts where wear is excessive. The United States Bureau of Engraving and Printing found that by chromium plating the intaglio plates used for engraving notes and securities, they could be made to last indefinitely, thereby saving thousands of dollars yearly. Formerly these plates had been coated with nickel, but the cloth used to wipe them soon wore away the surface so that they had to be replaced. With a coating of 0.0002 of an inch of chromium, the plates give a better impression and last much longer than nickel or face-hardened ones. When the chromium does finally wear slightly, the plates are stripped with hydrochloric acid and again chromium plated.

Chromium has been successfully plated on most of the common metals except aluminum. In the case of iron and steel, however, the danger of cracking of the plated surface makes desirable a coating of copper or nickel, or both, before the chromium is applied.

In chromium plating, the article to be plated is the cathode, while the anodes most commonly used are of the



CROSS-SECTIONS OF PLATED PIECES

Comparison of adherence, under a 1000-power microscope, of untreated and treated base metal, shown at the left and at the right

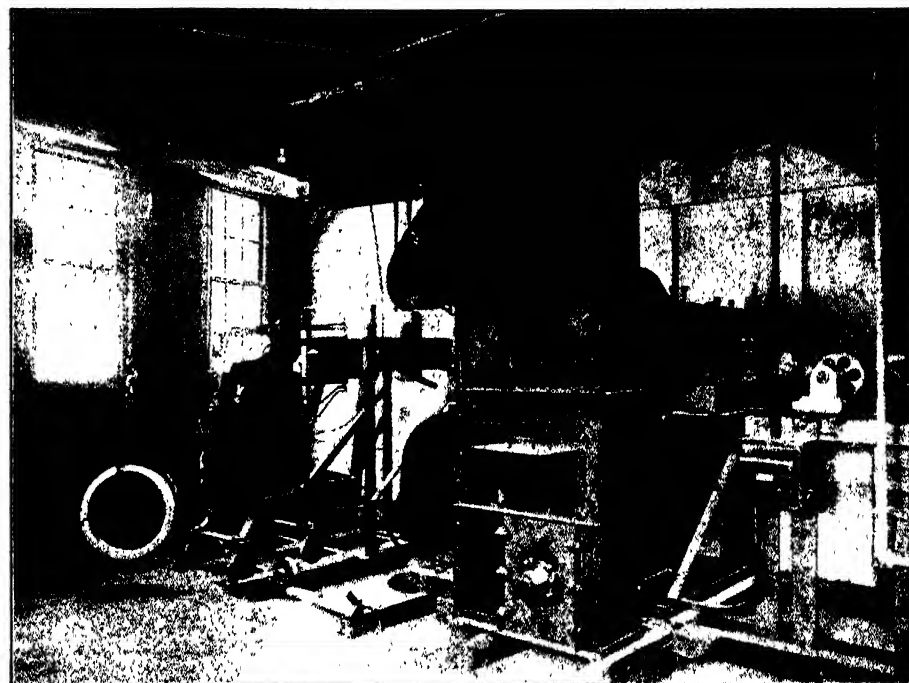
respectively, plated first with 0.002 of an inch of nickel and then with 0.0002 of an inch of chromium. The base metal was cold-rolled steel

insoluble type, lead being generally used. Metallic chromium, although readily soluble in acid baths, has not been used for anodes probably because pure chromium has been decidedly less expensive in the form of chromic acid or, strictly speaking, chromium trioxide. The chromium content of the bath is maintained by periodic additions of chromic acid. Steel, crockery, or lead-lined tanks are used as receptacles.

DURING the plating operation, a large amount of hydrogen is evolved at the cathode and oxygen at the anode. These two cause a fine acid spray which destroys the tissues of the respiratory tract. For this reason, ventilating hoods are sometimes used but these must not cause too close confinement of the explosive mixture of hydrogen and oxygen. Most often a sheet metal duct having a slot in the side facing the liquid, surrounds the top of the tank. When air is drawn through this duct at high velocity, a "suction blanket" is created over the surface of the liquid, effectively removing all fumes.

The character of the deposit may vary between wide limits according to the conditions of the operation and the control exercised, the kind of surface to be plated—the metal, its finish, and the kind of cleaning process through which it has passed—the composition and temperature of the bath, and, of course, the current-time.

In most cases, each article to be plated presents an entirely new problem. The exceedingly poor "throwing power" of the chromic acid bath and the consequent difficulty of obtaining a uniform thickness of deposited metal on an irregular piece, presents perhaps the greatest. This is usually overcome by arranging the



DEGASIFICATION OF METAL STRIP

Strips for the manufacture, after plating, of tubes or pipes, are run through this machine which degasifies and cleans them. From this point, they pass over rollers into plating bath at the right

racks and building the anodes to conform to the shape of irregular articles so that the current density over the whole cathode will be as uniform as possible.

Care must be exercised in chromium plating in so many ways that we could not begin even to outline them here. The degasification treatment, however, deserves special mention, since it marks a big step in the perfection of the process. This process consists of the removal from the surface of the metal, prior to plating, of the occluded and adsorbed gas which, if allowed to remain, will frequently cause cracking and scaling of the plated metal.

A number of attempts to degasify

metals have been made, but the one now receiving the most attention in this country is that developed by Mr. Charles P. Madsen. In this process, the metal is made the anode for a short time in a bath of 66 degree Baumé sulfuric acid at ordinary temperature. The voltage may be varied from six to 24 volts, alternating or direct current, and the current density from 25 to 50 amperes per square foot. This is not, strictly speaking, an electrolytic cell nor is the sulfuric acid an electrolyte. Neither is it a pickling bath since it removes deeply-imbedded foreign materials resulting from rolling mill operations, and other matter not ordinarily removed by pickling but which interferes with good plating and prevents close adherence.



STRIP PLATING

From the degasification machine at the extreme left, the strip is drawn through this nickel plating bath, over the rollers at the right, and through a similar tank for the final chromium plating

IT is said that all common metals, except aluminum, may be successfully degasified in a few minutes and that under proper operating conditions, the bath produces an extremely fine etching of the metal surface. This affords innumerable opportunities for the crystals of the plating metal to interlock firmly with the surface crystals of the base metal. Subsequent coatings of nickel, chromium, or other metal on the treated steel or other sheet, adhere closely in a film that is in the nature of an alloy between the base and the coating metal. Repetition of the treatment on the first coating gives good adherence for the second plating metal.

Chromium-plated sheets, bars, plates, et cetera, that have been treated in this manner may be bent, pressed, fabricated, or punched easily without flaking of the surface.

Sun Dials and Sun Dialling

*There Are Sun Dials of Many Types
to Suit the Purse and Skill of Every
Amateur Who Enjoys the Pursuit
of a Scientific Hobby*

By RUSSELL W. PORTER

Optical Associate, Jones and Lamson Machine Company
Corresponding Editor, SCIENTIFIC AMERICAN



MR. HARTNESS AND HIS DIALS

Figure 1: Former Governor Hartness of Vermont, well known inventor of machine tools, is also an amateur astronomer. He invented the enclosed turret telescope

THE usefulness of the sun dial has long since departed, along with the tallow dip, the ox cart, and the spinning wheel. Nothing is left but the romance and sentiment, and the wealth of solemn mottoes warning us that time is fleeting, and that

"As time and hours do pass away
So doth the life of man decay."

Except as a picturesque reminder of the past in the corner of some old rose garden, a dial has no part in our lives. When we can obtain the time over the radio accurate to a second's fraction any day or night; when we can carry it constantly in our vest pockets, why give this relic of the past a moment's thought?

THE present generation little realizes that until the invention of clocks and watches, sun dials were the only time keepers available, and that schools taught the art of dialling as an important study.

It is said that the first record of a sun dial is given in 2 Kings, XX, 9-11, where a miracle was performed by the Lord who made the sun's shadow move backwards some 10 degrees. This phenomenon has afforded a fruitful source of mathematical demonstration to prove the miracle possible—or impossible. One ingenious dial maker seems to have actually caused the sun's shadow to move backwards on the dial face, by making the face cup shaped and filling it with water. Refraction does the work.

Even were we dependent on sun dials today for our time, their accuracy would be of so low an order that they would be of little value. I do not suppose the average sun dial can be depended on to within a few minutes, for

the edge of the shadow cast by the gnomon, coming from so large a light source as the sun, is blurred and ill defined and therefore cannot be read with precision.

Now our civil time is really artificial, in that it makes the days all of equal length. Since our watches must run at a uniform rate they will not indicate sun time, because the sun appears to move faster at some times than at others. So we have created a fictitious sun that crosses our meridian promptly at 12 o'clock each day. The real sun is often ahead of, sometimes lagging behind, this fictitious sun and the difference between the times of these

they kept a different time from the sun dials and there arose the necessity of adding or subtracting this equation from the shadow readings of the dial, in order to give clock time. Many very ingenious devices have been applied to sun dials to accomplish this correction automatically without the need of tables and the necessary calculation. For, what one wants nowadays is to be able to step up to his sun dial and read off his watch time at once. The Hartness dial shown in Figure 1 is a good example of this class. Here a carefully formed cam, after being set to the day of the month, has moved the graduated hour circle about the gnomon just enough so that civil time may be read off directly. Even an allowance for leap year complications is provided for.



AN AUSTRALIAN INVENTION

Figure 2: This unusual sun dial gives the time on a common clock face, just as if it were an ordinary clock

two suns (between the sun dial and a watch) is a variable interval amounting at times to as much as 16 minutes—known among astronomers as the "time equation."

And so, when clocks came into vogue

A STRIKING advance in dialling has been made by the Government Astronomer of New South Wales, Mr. W. E. Cooke. This is shown in modified form in Figure 2. Its distinctive feature is that it permits one to read standard time directly from the face of a clock. This "clock" contains no springs or movement, but consists simply of a shell and the ordinary clock face and hands. When the large ring of the dial is turned so that the sunlight passing through hole A falls on the analemma on the opposite side of the ring, the hands of the clock, which are connected to the ring by means of a train of gears, are moved to the correct position. The case of the clock is fastened by a stud to the base at D and does not move as the ring is turned. The ring is mounted on a segment of a circle, so that the instrument may be set to the proper latitude. This dial also gives the date as well as the time of day.

Sun dials are of several types—horizontal, vertical, cylindrical, and

so on. In the familiar horizontal form the gnomon which casts the shadow is parallel to the earth's axis and points to the north pole of the heavens (in the northern hemisphere).

ALSO the dial face must be truly level. Should any one desire to make a sun dial for himself, full and elaborate instructions will be found in the "Encyclopedia Britannica" under "Dial and Dialling," while simpler rules are given in that delightful book, "Sun Dials and Roses of Yesterday" by Alice Morse Earle.

My own interest in sun dials has been aroused in the hope that in some way, perhaps by the aid of lenses, the time can be read to an accuracy of seconds instead of minutes. It has seemed to me that if

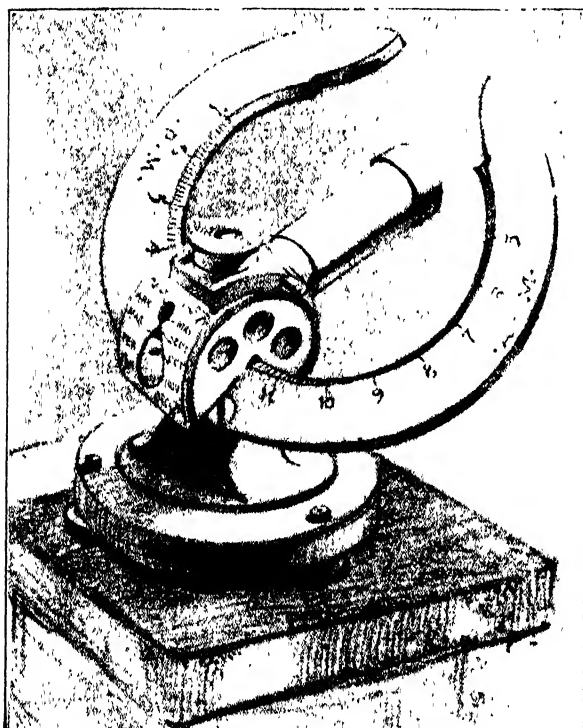


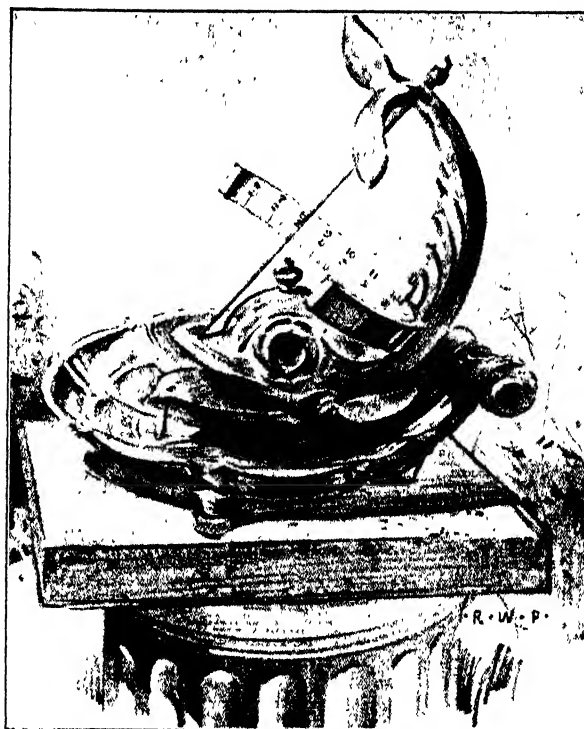
Figure 4. This one somewhat resembles a surveyor's transit tipped over until its horizontal plate is parallel with the plane of the earth's equator. Here, however, the telescope is lowered so that the sun's image is projected directly on the hour circle and read by means of the eye piece. At the same time the telescope is shifted laterally by setting on the analemma, thus compensating for the equation of time.

The other dial is shown in Figure 5. This was more complicated, and to understand its operation the reader must consult the section shown in the same figure, in order to follow out the path of the sun's rays.

The fixed hour circle is shown at A and is graduated on transparent celluloid. Around this circle is rotated the box B carrying the following optical train: prisms C, lens D, prism F, eyepiece G, mirror H, and ground glass screen J. What happens is this: The cover is turned until the sunlight passing through the lens forms an image of

STILL ANOTHER TYPE

Figure 4: This one is read by means of an eyepiece and will give accurate time when the adjustments are all made correctly



THE DOLPHIN DIAL

Figure 3: The dolphin carries the gnomon between his nose and tail. The dial is adjustable to the user's latitude

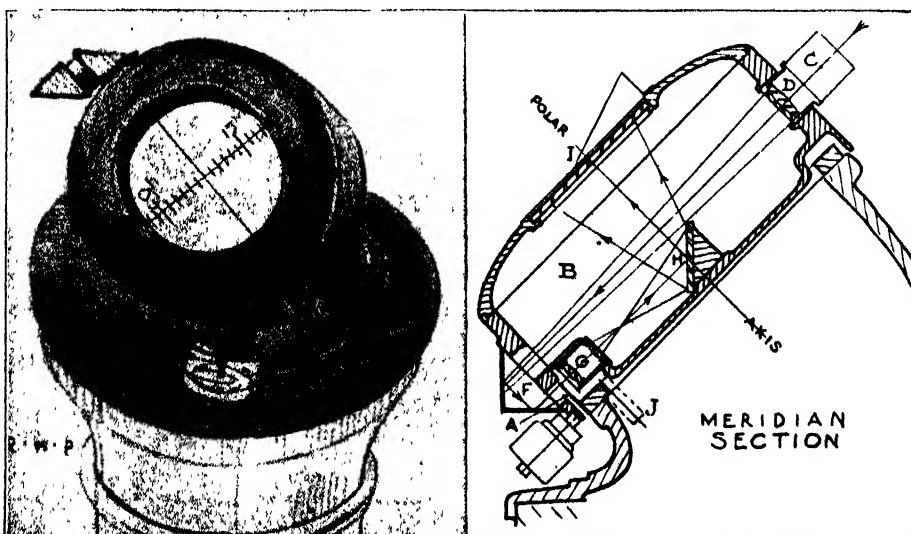
the sun on the transparent hour circle. The eyepiece then magnifies both this image and the adjacent graduations on the circle, projecting them upon the ground glass. The observer thus sees a picture of the sun about a half an inch in diameter, crossed by the graduations of the hour circle. The time equation is applied by rocking the dial box about the pivot T by means of a cam, as in the Hartness dial.

IT would be quite impossible to juggle with so many lenses, prisms and mirrors with anything less intense than sunlight. But there is such an abundance of sunlight that even a half-inch lens gives a brilliant image on the screen, and the last of these dials gave very

an image of the sun itself could be cast on the hour circle, definition of the sun's edge would allow much closer reading.

However my first adventure in dialling was more in the nature of a garden accessory (Figure 3). It might be called the dolphin sun dial and bird bath, in which the gnomon is a wire stretched between the animal's nose and tail. Also incorporated in this dial was the idea of leveling it up with water in the shell as a reference plane, thus making it independent of any leveling bubbles. The dolphin has a spherical seat and can be tilted until the proper latitude (marked on his tail) coincides with the water surface when the wire is brought parallel to the earth's axis. The equation of time is provided for by shifting the hour ring on the dolphin's back.

Two dials were made, using lenses and prisms. The first is shown in



RATHER COMPLICATED, BUT CORRESPONDINGLY PRECISE

Figure 5: The dial is shown on the left, the drawing on the right being a cross-section of it, permitting the reader to trace out the optical train. Precise readings may be obtained from it

consistent readings through most of last summer until a neighbor's boy satisfied his curiosity by pulling the instrument to pieces so as to see what was inside.

The easiest way for one wishing to

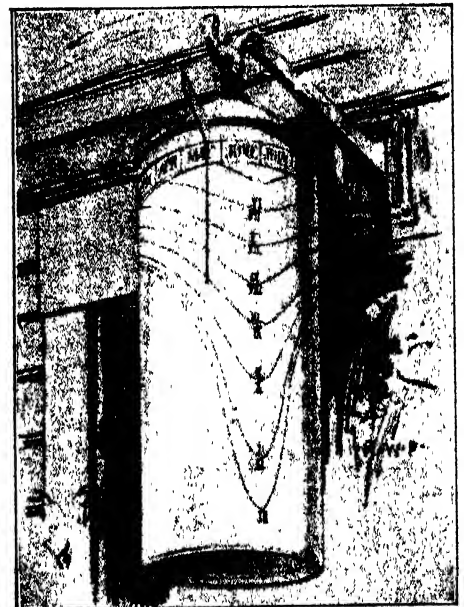
noon are crowded more closely together than at six A.M. or P.M. This can be equalized by shifting circle *A* to *A'* and extending the hour lines to meet it, but the foot of the gnomon must remain at the first center *O*. Also, if the

the meridian on which his watch is running. For example, the watch of a person in New York keeps 75th or eastern standard time. But he is one degree east of the 75th meridian and therefore four minutes fast, and his dial readings, corrected from the table, will be four minutes ahead of his watch.

Another way to accomplish this last correction is to rotate the dial face (not the gnomon) clockwise by this amount. For instance, when the New Yorker's watch reads 12 noon, the sun has already passed his meridian and is over the meridian of Philadelphia and (disregarding for the moment the table correction) the shadow on his dial reads 12:04.

So, if the dial is shifted until the shadow recedes to 12 o'clock, and then securely fastened, it will agree with his watch, and hence this correction has been provided for and may be forgotten thereafter.

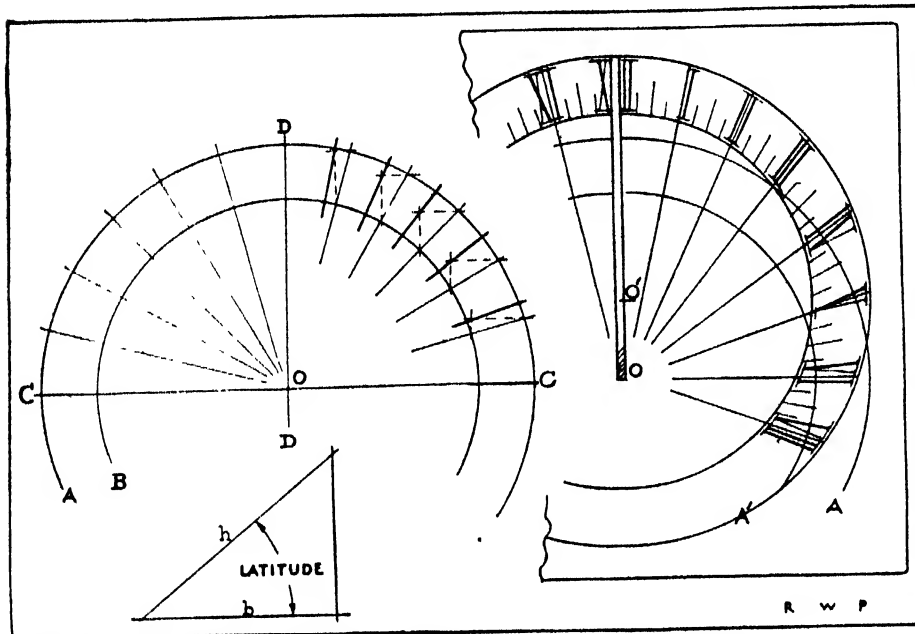
I WILL close with a reference to the cylindrical dial shown in Figure 7. In the one I have made, the curiously shaped curves were plotted on a sheet of paper, from data taken from the ephemeris of the sun, and then transposed to the cylinder itself. The computations required several evenings and covered many sheets of paper. If any one wishes to make a dial of this kind he will find full



DIFFICULT TO MAKE

Figure 7: Stile at top of cylinder is set to date and turned until shadow is vertical. Pyrenean shepherds use these dials today

instructions in Earle's "Sun Dials and Roses of Yesterday," already referred to. The cylinder, when used, must of course hang strictly plumb, hence it must be properly balanced and provided with a swivel at the top. The stile can be pushed in out of sight when not in use.



LAYING OFF THE COMMON HORIZONTAL DIAL

Figure 6: Simple dials of this type give approximate sun time from which standard time may be worked out by means of the relatively simple corrections described in the text of the article

make his own sun dial of the conventional, horizontal type is as follows: place a square piece of board on a pedestal and level it. The stile, or gnomon, may be cut from sheet metal having an angle equal to the latitude of the place. Fasten the gnomon to the board and line it up on the North Star by turning board and gnomon in axis-muth (horizontal plane).

AT near noon, when the shadow of the gnomon falls in line with itself, set your watch to 12 o'clock. As each hour comes around on the watch face, draw a line along the edge of the shadow cast by the gnomon. The next clear morning the hours may be drawn from sun-up to noon, and the half and quarter-hour divisions filled in at leisure.

Or the dial can be finished indoors as follows: First describe a circle *A* (Figure 6) with radius equal to the hypotenuse *h* of the gnomon. Then describe *B* with radius equal to the base *b* of the gnomon. Draw *CC* and *DD* at right angles to each other and subdivide each upper quadrant into six equal parts, connecting them with the center *O*. From the outer intersections draw lines parallel to *CC* until they cross lines from the inner intersections drawn parallel to *DD*. These new points of intersection are now connected with the center *O* and constitute the hours of the dial face, all other construction lines being erased. It will be seen that the hours around

gnomon has an appreciable thickness, as is likely to be the case, the circles must be separated into semi-circles with centers a distance apart equal to the gnomon's thickness. The gnomon is attached to the dial face, it is leveled and then turned until the plane of the gnomon coincides with the meridian; that is, until it faces true north and south. This last may be done by lining up the gnomon on Polaris.

A DIAL so constructed gives apparent or sun time. To convert this into mean (or watch) time a table should be attached to the dial showing how many minutes are to be added or subtracted from the dial readings to give watch time. This table follows:

Month	1st to 10th	10th to 20th	20th to 30th
January	+7	+10	+13
February	+14	+14	+13
March	+11	+9	+6
April	+2	-1	-8
May	-5	-5	-4
June	-3	-2	+2
July	+4	+5	+6
August	+6	+4	+2
September	-3	-7	-9
October	-12	-13	-14
November	-13	-12	-10
December	-7	-8	+2

One more and final correction will give standard time. The numbers given in the table should all be increased (or diminished) by a time interval equal to the number of minutes the observer is east or west of

Inventions for the Household



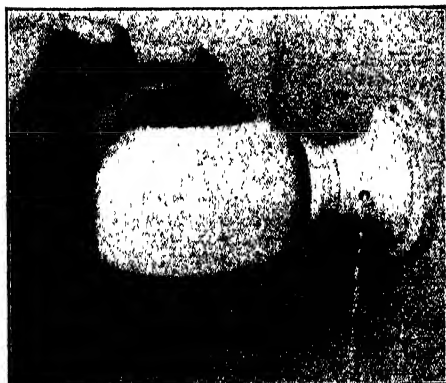
CAN OPENER

Many can openers of this same general type have been invented during recent years, but this one, which is imported from Germany, is particularly efficient and easily handled. A knife edge under the knurled screw cuts a smooth-edged hole, while the ratchet-like toothed wheel firmly grips the outer rim. It works speedily without danger to the hands.—*Lewis and Conger, 45th St. at Sixth Ave., N. Y.*



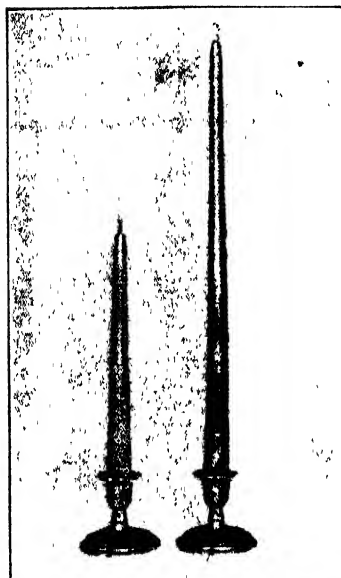
FOOD CHOPPER

This rocker blade with two wooden handles, imported from Czecho-Slovakia, is adapted to the preparation of chopped vegetables for small salads, et cetera.—*Lewis and Conger, 45th St. at Sixth Ave., New York*



RAZOR DRIER LAMP SHADE

This lamp shade over the man's shaving mirror should prove a welcome addition to his shaving outfit since it obviates the necessity of taking a safety razor apart for wiping. Heat from the lamp dries the razor as it rests in the recess above.—*Alfred D. Coons, P. O. Box 183, Berkeley, Cal.*

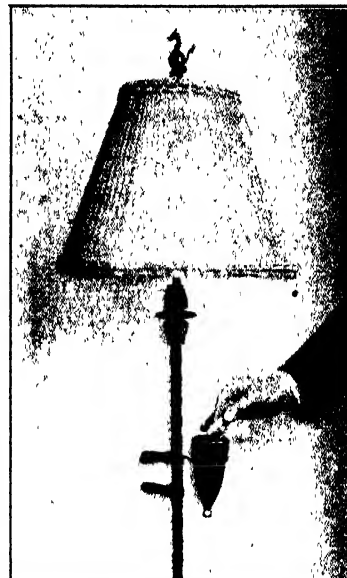


WOODEN CANDLES

These candles, made for decorative purposes only, are of wood, and will not melt in hot weather. They look as well as wax candles and last indefinitely.—*Kozy Kandle Studio, Omaha, Nebraska*

ASH CUP

Equipped with snap-on fasteners, this ash receiver fastens to a floor lamp or a bridge table leg.—*Detroit Tire Cover and Specialty Co., 49 Selden Ave., Detroit*



POTATO SPIRAL CUTTER

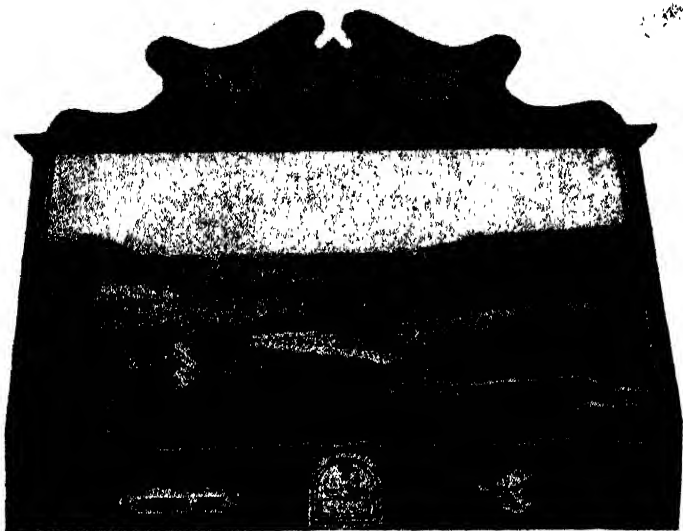
In using this French importation, a thin guide rod is first inserted in the potato; a sort of corkscrew attached to the end of the corrugated knife blade is then slipped over the rod; and the blade is turned around the potato. The screw "leads" the blade in a spiral, so that, finally, the potato is cut into a continuous spiral strip, ready for deep, or "French," frying.—*Lewis and Conger, 45th St. at Sixth Ave., New York*



PEA HULLER

The principle utilized by the small boy who shoots peas into one's eyes by squeezing the pod has been made use of in this device. Insert the full pod between the two rollers, turn the crank, and the peas are squeezed out as the hull passes through the "wringer."—*Home Pea and Bean Hulling Machine Co., Marietta, Ohio*

Inventions New

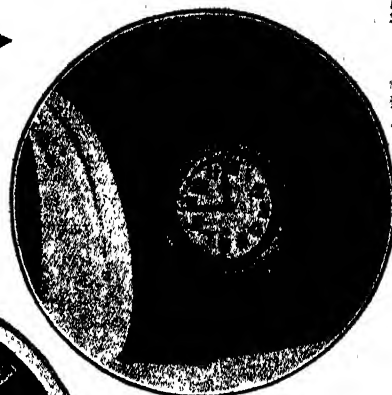


COIN-SLOT GOLF GAME

With this artistically designed amusement device, a regular nine or 18-hole game may be played. When a lever is pressed, the automatic golfer hits the ball which may make a hole-in-one or be "lost" in the painted lake. The player drives the ball first over the bunker into hole number 1; then over the bunker and brook into number 2; and finally, a long putt lands it in number 3. An automatic score-keeping device is attached. —Chester-Pollard Amusement Co., 188 W. Fourth St., New York

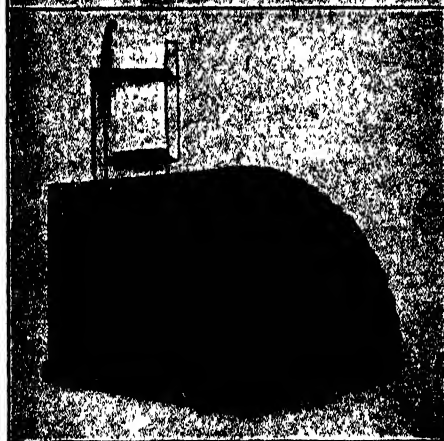
SELF-WINDING WATCH

Since this watch has no winding stem, the case is impervious to dust and dampness, and its lubricating oil does not, therefore, deteriorate. Overwinding and breakage of mainspring is impossible



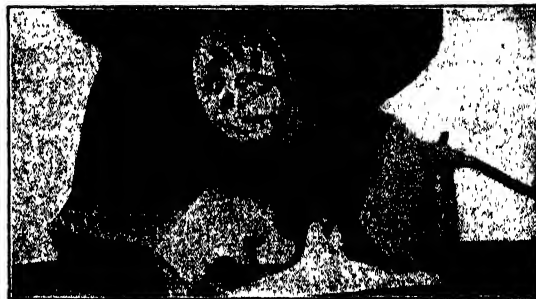
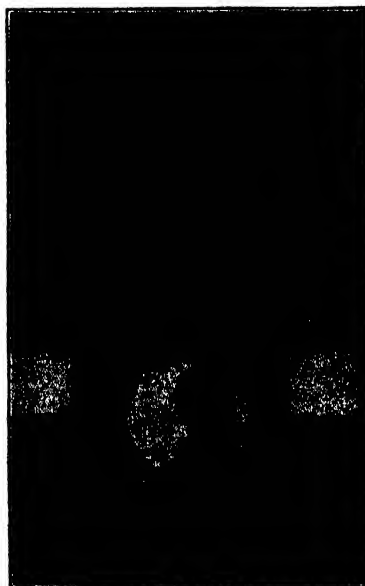
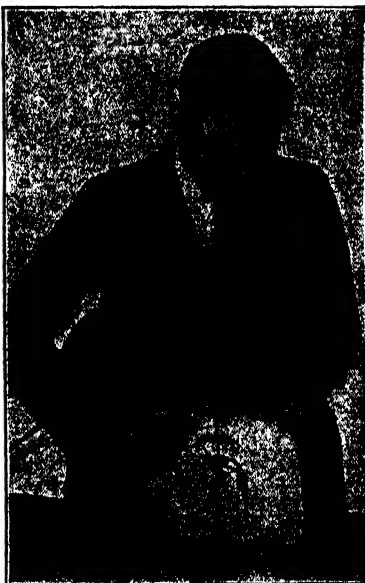
MECHANISM

Body movement actuating a pendulous weight, keeps this watch fully wound at all times. Its simple mechanism is shown at the left. —The Harwood Selfwinding Watch Company of America, Inc., 64 W. 48th St., New York



TYPEWRITER COVER

Comparable to a roll-top desk, this cover for the typewriter that does not have its own folding desk, is strong, dust-proof, and disturbance-proof. The folding top, made of strong fabric folded like an accordion, may be locked in place when closed. When open, there is nothing to interfere with satisfactory typing. An attached copy holder adds to its convenience. —Krieger Novelty Company, Lodi, Cal.



PORTABLE SANDER WITH VACUUM

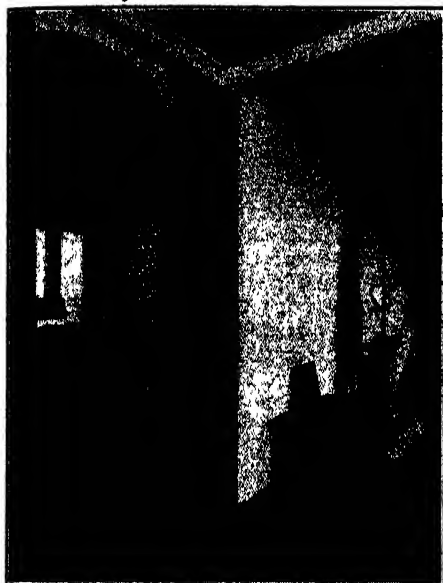
Designed and built for sanding table tops, lumber, base boards, et cetera, this sander also has its own vacuum which takes up all the dust. Work may be passed over it as it rests on a special base. At the left, it is being used on a table top; and above, the man is holding the machine, disassembled, showing the sanding roll which is the only moving part. Speed is 1800 revolutions per minute. An attached bag catches the dust. —The Reid-Way Company, Cedar Rapids, Iowa



CONNECTOR SOCKET

This new socket may be used either at the ceiling outlet or at the hanging fixture. Two lugs on the plug end, one short and the other long with a loop for holding the weight, are arranged to be inserted into a slotted plug. Above is shown a close-up, and at the left a workman is removing a fixture, without dismantling it, to be carried to a more convenient place for cleaning. —Artistic Lighting Equipment Association, 480 Lexington Ave., New York

and Interesting



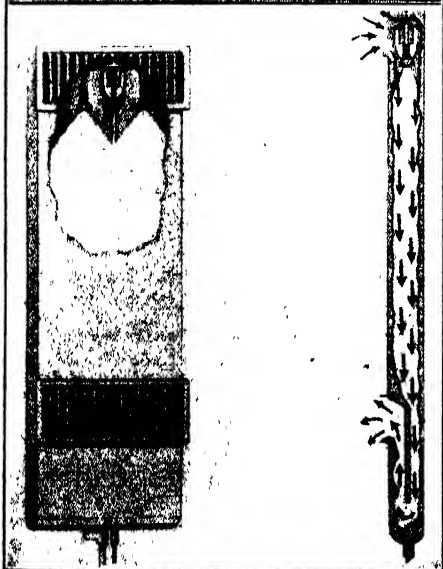
GOLF CLUB GRIP

Teachers of golf stress the necessity of holding the club in the fingers of the left hand. This device makes you take right grip because it automatically lowers the left hand and turns it palm downward. It has the effect of strengthening the left hand and controlling swing.—*The Rite Grip Co., 335 Richardson Building, Toledo, Ohio*



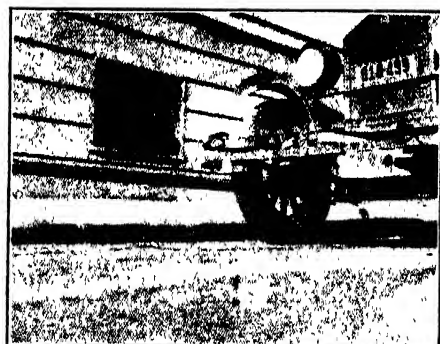
WINDOW-VISOR HAT

A section of green pyralin is inserted in the visor of this sport hat to shield the eyes from the direct glare of the sun. Wearing it, an automobilist may drive safely toward the setting sun, or a golfer may watch the flight of his ball without straining his eyes. The hat is adjustable to all head sizes.—*Superior Hat Co., St. Louis, Mo.*



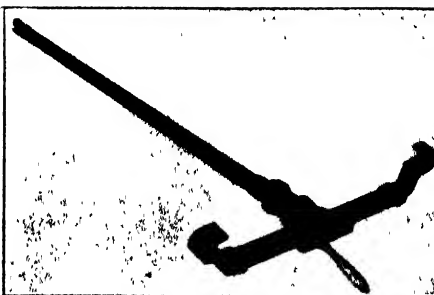
WASHED AIR SYSTEM

Above, under the arch, is shown an installation of the system sketched beneath. Air is drawn in through the upper register by the suction created by the water spray. The air is washed clean and thrown out at the lower register.—*Zephyr Washed Air Company, Minneapolis, Minn.*



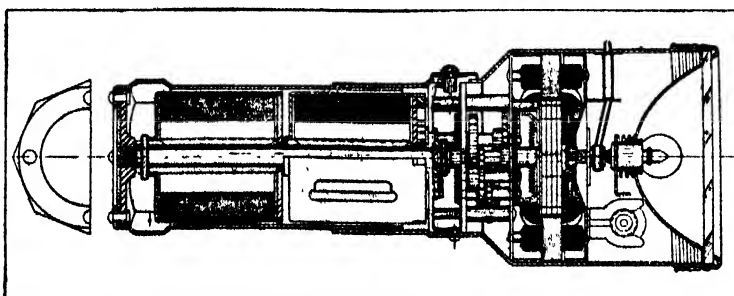
TOWING ATTACHMENT

In the illustration at the left is shown an adjustable steel clamp which, attached to the front springs of a car, provides a connection for a towing bar. It is rigidly fastened so that the towing bar cannot damage the front apron while the stiff bar prevents a smash in case of a sudden stop. Above are shown two photographs of the device in place.—*Kimmerle Brothers, 226 Eleventh St., San Francisco*



WINDING

The dynamo flashlight, cross-section of which is shown at the right, is wound by turning the two ends in opposite directions



A NEW FLASHLIGHT WITH ITS OWN GENERATOR

Sectional view of the flashlight that makes its own electricity. The generator is operated by a spring motor which runs for nearly three minutes after winding. Pressing the button starts the generator, which produces electricity at two and one half volts. It is not affected by dampness, will flash under water, and will last indefinitely.—*Campbell Manufacturing Co., Long Branch, N.J.*



FLASHING

On pressing the button, one hears a hum as the spring-driven generator of this flashlight goes into action, giving a bright light

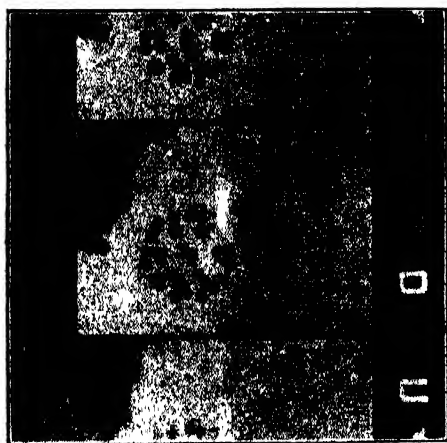
The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

Similar Birthmarks in Five Generations

A FAMILY in which nine individuals have been spotted by birthmarks in five generations was described by Dr. Arthur H. Estabrook, of the Eugenics Record Office, at the meeting of the Eugenics Research Association in New York recently. The significant point stressed by Dr. Estabrook was that the spots occurred in similar parts of the body in the different generations; so that apparently, not only the spots, but their location as well were inherited.

Certain types of birthmarks may develop into skin cancers, Dr. Estabrook pointed



"Movie" of a micro-organism found in pond water. Made up of green dots, the circle revolves constantly

out. For that reason the inheritance of birthmarks is of particular interest, in connection with the possible inheritance of skin cancers.—*Science Service.*

Motion-Picture Photomicrography Simplified

NO longer is motion-picture photomicrography confined to the laboratory of the specialist with thousands of dollars worth of equipment at his command. Two little devices which have recently appeared, make this work remarkably easy for the owner of any 16 millimeter amateur motion-picture camera, or for the owner of any other motion-picture camera. With the aid of these two devices, moving picture studies of micro-organisms may be made easily.

The first attachment is a prismatic device which rests over the microscope ocular. By means of a partly silvered prism, 1 percent of the light is transmitted to the eye for controlling the subject, while 99 percent goes to the film to register the image upon its sensitive surface.

This adapter has an eyepiece, the field of which is a pale green. In this field there is a colorless rectangle which coincides with the camera field. These colored fields are interchangeable for use with either amateur or

professional cameras or for still cameras.

The second device is a prismatic focusing device which enables the operator to focus the image accurately upon the camera field (film), to make sure that the visual and camera foci coincide.

Using a conventional microscope arc lamp and a very small aperture in the microscope condenser iris diaphragm, the automatic cameras may be operated at normal speed with the assurance of securing a fully exposed negative.

Remarkable results have been secured with this apparatus by amateurs at their first trial. This success opens up a promising new field to educators and to students, as well as to the great army of amateur cinematographers who are interested in this new work.

Powerful Wind Motor Generates Electricity

A MACHINE using neither fuel nor electricity, which generates 150 to 175 horsepower, has been erected and is being extensively tested in the region of the Coachella Valley, California. The success of the experiment which has been carried on for the past few months indicates that this device can utilize the power of the wind as economically as turbines can utilize water power.

This machine, known as a wind motor, consists of a funnel-shaped tube of heavy sheet metal approximately 100 feet long, the large end being about 15 feet in diameter. The funnel is mounted on a pivot and supported by a massive steel frame of riveted angle iron. This frame rests upon

a circular double track and the mounting enables the machine to be pointed with its large end toward the wind. A draft of air is developed into a 10 to 20-mile wind. As it passes through the funnel, it propels a fan which is connected with the generator. This generator and the controlling mechanism are contained in a sheet-metal housing mounted within the angle-iron frame beneath the funnel. The machine contains several tons of steel.

Tests made with this machine together with accurate weather reports showing wind averages over a period of years, have prompted the inventor to project a series of them at favorable points throughout the west. It is proposed to locate these in mountain gaps and other points where wind is prevalent. In the locality where this initial installation has been made, there is an operating wind 90 percent of the time.

If the proposed units are not too widely separated they will all be placed on the same electrical circuit, thus providing a source of continuous power. The plan is to make the new wind machine about four times as large as the present model.

New Dust-proof Electric Motor

ALTHOUGH the standard open frame squirrel-cage motor meets most of the requirements for ordinary service, it has certain disadvantages which become rather serious in many applications. For example, when it is operated in a dust-laden atmosphere, its air passages soon become clogged. This causes overheating unless the motor is frequently cleaned. An even



The new "micro-movie" equipment in action. Making animated photomicrographs that can later be thrown on a screen and studied at leisure

more serious condition exists in cases where the air is laden with metallic dust—particularly iron dust — because this metallic dust works into the windings and may in time cause a breakdown of the insulation.

Several attempts have been made to overcome this difficulty by the development of enclosed, self-ventilated types. One recently announced by Fairbanks Morse and Company has also an interesting air cleaner device.

This motor has a standard stator core and windings and a standard rotor mounted in a supporting shell with an annular air passage between the outside surface of the stator core and the shell. Winding shields are provided so that the stator windings are totally enclosed, thereby preventing any dirt from gaining access to these windings. Cooling air is drawn through an inlet opening at the free end of the motor by means of a special type fan which also functions as an air cleaner. The clean air is blown across the winding shield at the free end of the motor, through the annular air space, then across the outer end of the stator core

slot between the inner and outer bars, are pulled down towards the inner bars, closing the small leakage gap in the rotor iron. This almost completely chokes the current in the inner low resistance winding by forming a complete iron circuit around each inner bar.

This choking action on the inner winding forces practically all of the current to flow in the outer high resistance winding at starting, thus producing a high starting torque with a low starting current. As the rotor accelerates, the iron rods are thrown out of the leakage gaps by centrifugal force, thus removing the choking effects from the inner winding when the motor is running.

The important advantages of this type of motor are: 1. It is completely self ventilated and cleans its own cooling air by means of a built-in automatic air cleaner; 2. That it is impervious to dust and dirt in the air; 3. It is built in the same frame diameter as standard motors of corresponding horsepower; 4. No air piping of any kind required; 5. Will operate in the dustiest locations without requiring any



Looking toward large end of wind-power generator showing circular track on which it turns, and the housing for the machinery



View of the wind-power generator installed in a California valley

laminations, thence across the winding shield at the pulley end and out through openings in the pulley end-bearing arm.

The fan is of the closed impeller type and is so constructed that the foreign particles are thrown out by centrifugal force, between the edge of the outer shroud and the supporting frame. A perforated guard is placed around this fan-cleaner and is carried by the supporting frame.

In this variable leakage, double squirrel-cage type motor, the current in the inner winding at starting is choked by means of iron rods. The instant the motor is connected to the line, these rods, in each rotor

blowing out; 6. Reduces fire hazard as the windings are totally enclosed and the air for ventilation does not come in contact with them; 7. It requires no more attention than a standard ball-bearing motor.

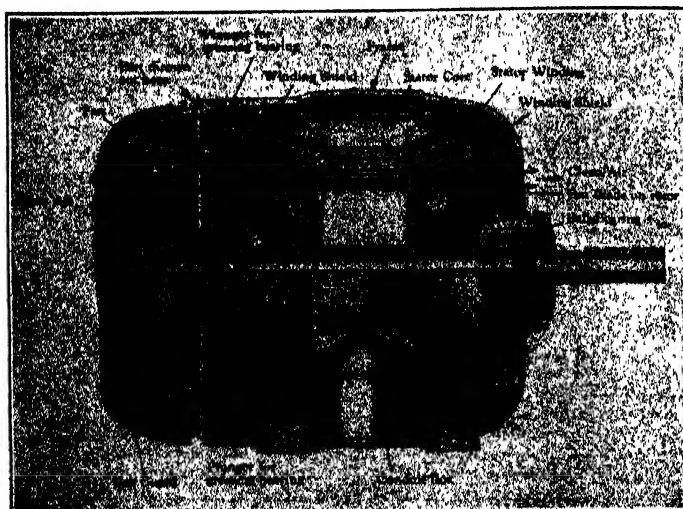
Harpoon Gun For Fish

A GUN, with an attachment for harpooning fish, the whole somewhat similar in operation to the whale harpoon gun, has been invented in France. Since this gun is to be fired from the shoulder like any ordinary gun, it was necessary to

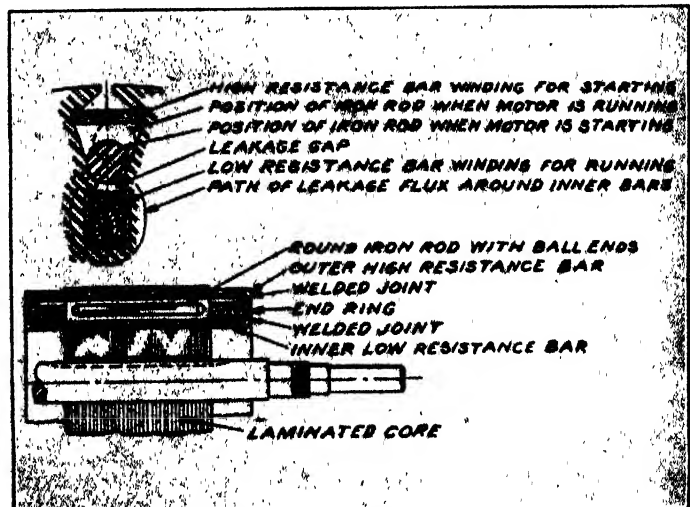
make it as light as possible. The total equipment consists of the gun, a harpoon, a line, and a float, all compactly arranged together.

The gun is of a standard French type and is not changed in any way except that two screw-like grooves have been cut in the end of the muzzle. Two studs on the front of the harpoon slide in these grooves, thus imparting a rotating motion to the harpoon as it leaves the gun. A tube is attached to the muzzle of the gun below the barrel, to hold the round metal can which, in turn, holds the line and the float. The light can container is open at the rear end but is closed in the front, having only a small hole through which the line is drawn. The line is attached to the harpoon just behind the dart. A length of ash is fitted to the dart, giving a total length of about 16 inches.

The standard cartridge from which about half the powder charge has been removed,



The windings of this motor are totally enclosed with winding shields, and the fan is designed to throw out dust and dirt



Section showing improvement in double squirrel-cage motors. Loose iron rods are inserted in the rotor slots between bars

cutting away of the banks on "outside" curves during periods of high waters, according to an article by W. W. DeBerard, in a recent issue of *Engineering News-Record*. Formerly such revetments were made up of willow mats, but it was found that these concrete mats could be laid for 225,000 dollars a mile against a cost of 300,000 dollars per mile for those made of willow.

The articulated type of concrete mat is made up of strips 25 feet long containing 25 slabs, each three inches thick, 11 inches wide, and 3 feet 11 inches long, these being strengthened and connected with wire mesh. They are cast on barges, one layer being placed on top of another as fast as the concrete sets, sheets of treated paper being placed between to prevent sticking. Setting time of the concrete varies from six hours in summer to 24 hours in winter.

In laying these mats, a long steel barge loaded with them, having a skid on one side, is hauled close to the river bank and parallel to it. The upper end of the barge is fastened by cables to a set of main mooring barges which project outward into the river. These barges are connected by cables to an upstream set of mooring barges by cables attached to winches by which the main barges are shifted as the work proceeds. The mat cables are then made fast ashore and the first mat section laid down as the mat barge moves away from the shore. Another section is laid upon the skids, its cables fastened to those of the first, and the launching process continued until the launched mat extends a sufficient distance outward from the bank along the river bed. Having thus laid a mat 140 feet wide and 200 to 300 feet out into the stream, the whole apparatus is shifted to lay another mat upstream. The process of laying mats and shifting position of the mat barge is continued until adequate protection is effected.

By this method sections of the river bank have already been protected successfully. According to the present method of operation, the sinking plant can easily

place an average of 70,000 square feet in a day. For average widths of revetments this covers about 265 linear feet per day or just one mile each working month.

"Lexington" Sets New World's Records

AFTER breaking the world's ship speed record three times in as many days, the United States aircraft carrier *Lexington*, one of the mightiest ships of her kind afloat, made a further record for the speediest passage from California to Hawaii when she went to Honolulu in June to join the fleet. She made the 2228-mile trip from San Pedro, California, in 72 hours, 84 minutes. The best previous record was made by the light cruiser *Omaha* in 1923 when she steamed the 2091 miles from San Francisco to



Courtesy Engineering News-Record

Cutting the cables of a mat section already laid, preparatory to moving to a new position upstream



Mr. Gomez and his tiny motor and elevator mechanism which stands beside a pencil for comparison

Honolulu in 75 hours, 40 minutes, and 40 seconds.

On the first day out, the *Lexington* broke the world's distance record for 24 hours by covering 700 miles in that period. This is 10 miles better than the best day's run of the *Omaha*, previous holder of the record, and 24 miles better than the record for merchant ships made by the *Mauretania* in 1911.

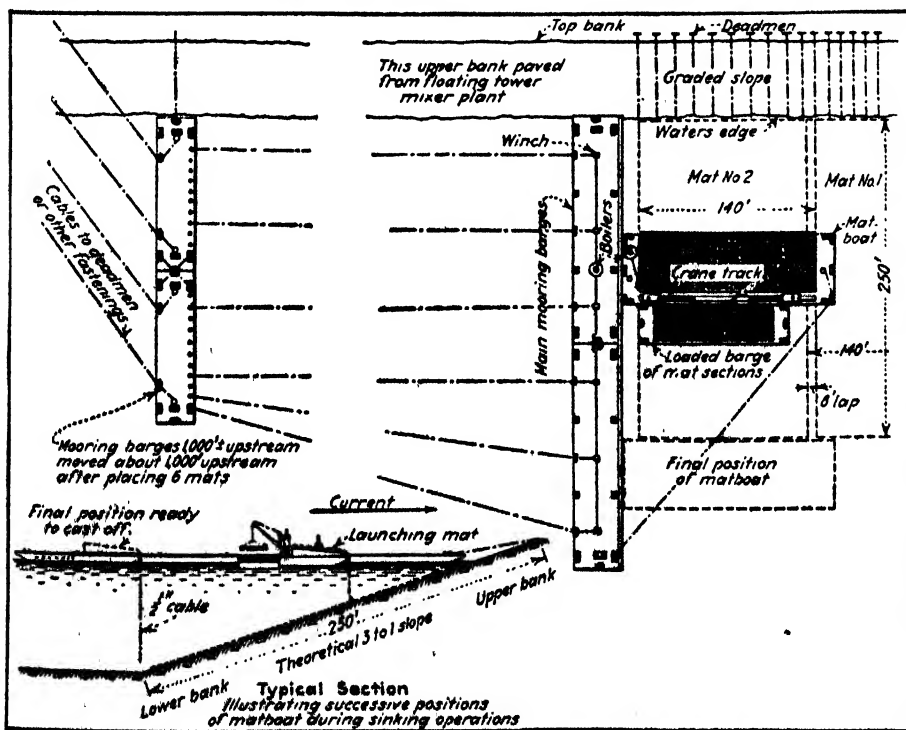
During the second 24-hour run, the *Lexington* logged a total of 742 miles. The remaining distance of 786 miles was made in 24 hours and 84 minutes, so it is calculated that for the third consecutive 24-hour run she traveled 770 miles.

Miniature Electric Motor

A WHOLE tribe of "midget" motors seems to be springing up. Since we published an item concerning one in the March issue, another was called to our attention with the claim that it was the smallest in existence, and we mentioned it in the June issue. A few days ago, Gabriel Gomez, a student from Colombia, South America, now residing in New York, personally brought in a third. While this third one is not the smallest, it is the first of the tribe that the editors have had the fun of examining and operating. It is small, and it certainly does hum.

Mr. Gomez says that he came to New York some months ago to attend an electrical school. For a while he worked with a watchmaker and there became familiar with the delicate machinery used in making or repairing watches. After months of study in the electrical school, his father desired to know how much he had learned and accordingly promised him a trip to Spain if he could make a tiny motor that would run. It took Mr. Gomez just two months of spare time to complete the job.

This latest member of the tribe is slightly (Please turn to page 177)



Plan and cross-section of the concrete-mat-laying plant. This shows the main, mooring, and mat barges, and other equipment. It is self-explanatory

Learning to Use Our Wings

This Department Will Keep Our Readers Informed of the Latest Facts About Airplanes and Airships

CONDUCTED BY ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York City

Flight Without Power

THE basic principle of a kite is that it is maintained stationary relative to the earth, while the wind sweeps by it, so that lift follows from the availability of a rela-

Anthony Fokker exhibited at a Paris Aero Show an engineless machine which was to be towed behind an airplane, with the general idea that goods or mail could thus be delivered at intermediate points without interrupting the flight of the towing

It remains to be seen however whether the process will be practical in rough weather. Owing to the distance apart of the craft they may be struck by gusts of different direction and intensity and peculiar problems in dynamics and stability will have to be studied and met.

Air Terminals

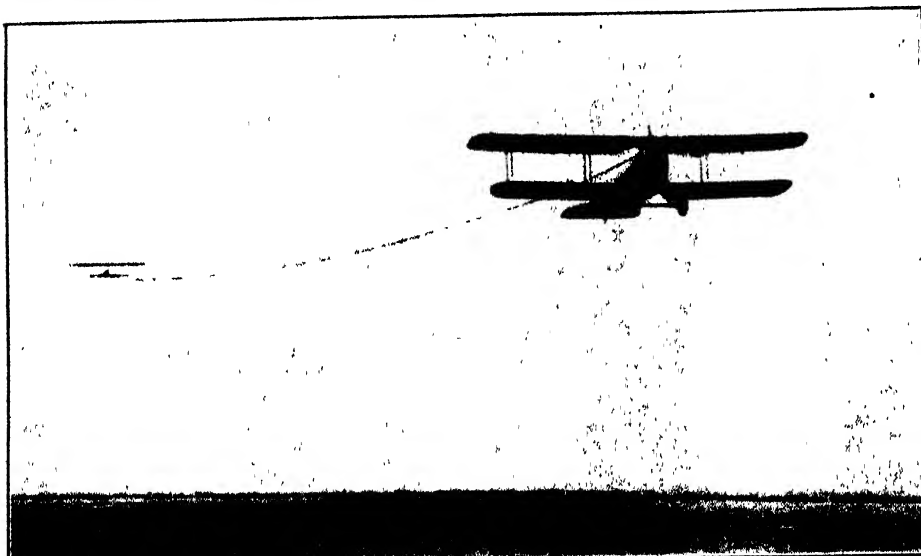
THE French lead the world by their imagination. It is not surprising that the full conception of what an air station should be comes from a young French architect, Maurice Chauchon, who recently arrived in New York on a traveling fellowship of the American Institute of Architects. His prize-winning plan for an airport will be embodied in a proposed terminal at Pau, France, 50 miles from Bordeaux.

The air station will be 370 feet wide and 260 feet long. The huge arches will be, however, only 40 feet high at their center portion, since even the largest planes are comparatively low in overall height. Tractors will pull the planes into position inside the hangars, and passengers will thus be protected from weather conditions. The huge hall will contain arrival and departure platforms, air mail service offices, customs house, the weather service, restaurants, cafés, et cetera.

There will be provided facilities for testing engines, underground fuel reservoirs, garages for automobiles, rooms for pilots and mechanics and other employees, a power station and every other possible convenience. Daylight illumination will be provided by a roof of glass slabs set in reinforced concrete. At night two vertical beams of 1,000,000 candle power will guide the pilots. Two lateral beams will sweep the ground for landing. The name of the airdrome will be sunk in the ground and illuminated. As a whole, the plan is magnificent and realizable.

First Tourist Air Cruise

THE American Aviation Tour of Europe is announced under the auspices of the North German Lloyd, the Luft Hansa,



F and A

A glider being towed by an airplane. See photograph below

tive wind. If the kite is loosened from its moorings, it first assumes the forward velocity of the surrounding atmosphere and then drops to earth.

A glider can only remain aloft in an upward current of air. If the wind is steadily horizontal, it must sink to earth sooner or later.

A German, Wolfmüller of Munich, makes the very ingenious suggestion that by the use of two gliders, a kite could be obtained which would not have to remain stationary relative to the earth.

There is almost always in the air a velocity gradient with altitude. The wind at 500 feet above the ground is greater than the wind at 200 feet, let us say.

Now if we imagine two gliders, one considerably higher than the other, and allow that there is such a velocity gradient, then we can conceive that the entire system will be carried along by the wind at some speed between the velocity of the upper wind and the velocity of the lower wind. The upper glider will receive lift if it faces the wind, the lower glider if it has the wind on its tail, as will be apparent from a little reflection, and the entire system stays aloft and travels in the general direction of the prevailing wind!

Calculation will probably show that the available lift will be very small, but theoretically at least the notion is plausible.

Towing Gliders

TOWING glider targets has been a practice of the United States Army Air Corps for many years. Several years ago,

airplane. It has remained for the Germans however to experiment with the idea.

The Raab-Katzenstein glider, a small biplane of some 180 square feet in surface, was employed in these tests. The glider was attached to the towing machine by a long cable fixed to the center section of the plane and to the nose of the glider. Quick release gears were fitted on each end of this cable so that the pilot of either machine could free it as required, and a light tubular guard was fitted above the fuselage of the towing plane to keep the cable clear of the rudder and fin.

At the first attempt to get off, the lightly loaded glider left the ground and climbed rapidly before the towing machine had attained flying speed. The glider pilot released himself and landed. A second attempt was more successful.



F and A

A glider being attached to the end of the tow line. Notice the long tube above the fuselage of the plane to keep the tow line clear of the rudder and fin

This grainless wood board is writing a new page in the drama of progress!

Possesses remarkable workability—won't crack or split. Revolutionizing methods of manufacturing in many industries. New uses discovered almost every week. Send for large free sample and find out what Masonite Presdwood will do for you.



FOR SIGN BOARDS

Here is a creation of modern inventive genius that is challenging the imagination of manufacturers in scores of industries, and that has already made it possible for a number of them to reduce their operating costs, improve their products and broaden their markets.

A genuine all-wood board which is absolutely *grainless*! A board that positively will not crack, check, split or splinter. A board of uniform strength and truly remarkable workability! — That, briefly, describes Masonite Presdwood.

And yet these are only a few of the many advantages of Presdwood. It is very dense and tough. It is highly resistive to moisture. It has a smooth, attractive surface on the face side, requires no paint for protection, and takes any finish beautifully.

Can be cut and milled

Presdwood is simply wood torn apart and put together again. It contains no foreign substance; not even a chemical binder. So it cannot damage tools.

Presdwood comes in a four-foot by twelve-foot size. It can be used on any woodworking machinery. It can be cut out, punched, die cut and milled. In fact, Presdwood is adaptable and workable almost beyond belief.

From doll houses to bridges!

There seems to be practically no limit to the uses for Presdwood, and new uses are being discovered week after week.

Candy makers are now using Presdwood for starch trays, and in the Chicago Art Institute it is backing and protecting rare works of art.

Store fixtures of many kinds, incubators, clothes hampers, bedroom screens and fire screens are made of Presdwood; so are work-bench tops, bread boxes and concrete forms.

You will find Presdwood as paneling in the new Pullman cars of several leading railroads; you will

find it made into tension boards for many radio speakers. Large halls and pavilions have floors of Presdwood; and it is already beginning to go into fine office buildings, apartment buildings and homes for the same purpose.

Toys are made of Presdwood; trunks, wardrobes, bank vaults, and telephone booths are lined with it.

There are kitchen cabinets, shelving, and office partitions of Presdwood; thousands of feet of it are used in making movies; there is now a demand for it in the construction of dams.

In brief, Presdwood uses range from doll houses and invalid trays to bridges and flumes!

Withstands the wear of all outdoors

Out in the open country—there, too, Presdwood is proving what an enduring, adaptable material it really is. Water, wind and scorching sun have little effect upon it, even when it is left unpainted. Steadily, persistently, it withstands wear and tear that have wrecked many another material in a comparatively short time.

Presdwood is being used for speed boats—alike on the Gulf of Mexico and the lakes of Wisconsin. Campers' tables are made of Presdwood; so too are safety wheels for bathing beaches, and particularly signs—all kinds of signs. Holstein and Guernsey Breeders, for example, are using Presdwood sign-boards in Wisconsin, Minnesota, Iowa, Nebraska, the Dakotas, and as far west as Idaho.

And so the list of Presdwood uses might be continued for many paragraphs. We suggest that you put this *grainless* all-wood board to the test yourself. It may be exactly the material you are looking for. Write today for large free sample. It will be sent promptly on request.

MASONITE CORPORATION

Sales Offices: Dept. 1688, 111 W. Washington St.
Chicago, Illinois

FOR PLAYHOUSES AND TOYS

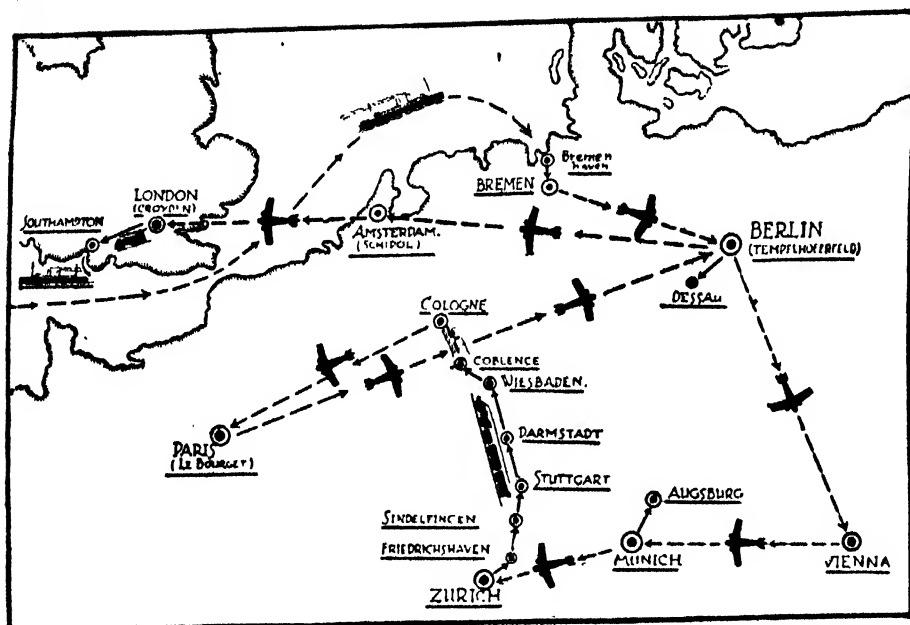


Mills: Laurel, Mississippi

Masonite
PRESDWOOD
Made by the makers of
MASONITE STRUCTURAL INSULATION

FOR BUILDING BOATS





Itinerary of the American Aviation Tour of Europe, under the auspices of the Luft Hansa Imperial Airways, the French Air Union, and other organizations. Regular scheduled flights are to be started during the coming fall

Imperial Airways, the French Air Union, and other powerful organizations. It will cover 2700 miles in the air, through Germany, Austria, Switzerland, France, Holland, and England. Famous factories in Europe will be inspected, passengers will travel in a variety of planes and for a change will travel short sections of the journey by rail. The success of the tour this fall will be awaited with interest.

Law of Aviation

THE principles of law apply in aviation, just as in any other human activity. But there must be, nevertheless, new statutes, definitions of new principles, precedents to be set up in the courts. And therefore books on aviation law are beginning to appear.

Fixel's "Law of Aviation," (published by Matthew Bender, Albany) makes interesting reading. At the first peace congress, called by the Emperor of Russia, the throwing of projectiles from dirigible balloons or any other aircraft was prohibited! The earth can be appropriated, said the lawyers, the air cannot; it is in the nature of common property. There are now International Aviation regulations, the Air Traffic Regulations of the Department of Commerce, and state aviation laws which are patterned after the Federal regulations for the most part.

Fixel's book will be of interest to aircraft operators as well as to the lawyers.

The Sportsman Aloft

IT is most interesting to read what George M. Pynchon, Jr., noted sportsman and financier writes in the *Sportsman*. People professionally interested in aircraft have no false modesty in airing their views. But it is seldom that a member of the general public will set down his views on aviation on the printed page. Discussing the first solo flight, Mr. Pynchon says:

"The much advertised first solo, a curse to everyone who has to listen to the soloist, is all that, and a good deal more than, it is supposed to be. The front cockpit looks awfully empty, the ship feels different—because it is lighter—and there are usually

a lot of people on the ground waiting to see the carnage when it lands. But the white handkerchief tied to the tail of one's machine is a challenge and there isn't any carnage, and it's probably the best landing one will make in a month, for later one has relapses when the wheels hit the ground at 60 miles an hour, the ship bounces into the air and one blesses the sturdiness of the undercarriage."

Loops, according to Mr. Pynchon are always an agreeable diversion. Hours of practice are advocated to learn dead stick landings. Flying is not expensive for the would-be sportsman-flyer. Good planes are available at 3000 dollars. Although these are of the open cockpit type, they provide more feel of the air than the larger and more expensive cabin types. On the whole, Mr. Pynchon thinks flying safe for the sportsman, provided he takes due pains to learn and takes no unnecessary risks. A most encouraging article both for the aviation people and for the would-be airplane owner.

A Collapsible Chock

WOODEN chocks for airplanes have been used for many years. They are placed at the front of the wheels to keep

the plane from moving until the pilot has had a chance to try out his engine and warm it up when necessary. The wooden chocks in use thus far have been somewhat clumsy affairs however, and are hard to stow on board a small plane.

Now an English firm has brought out a metal chock, consisting of three plates of stout duralumin, hinged together and so arranged that they may be either opened out to form a triangular block of the same section as usually given to wooden chocks, or folded flat for transport. When folded they take up very little space and should be very useful for private cross-country flying which may necessitate landings in isolated places away from regular airdromes.

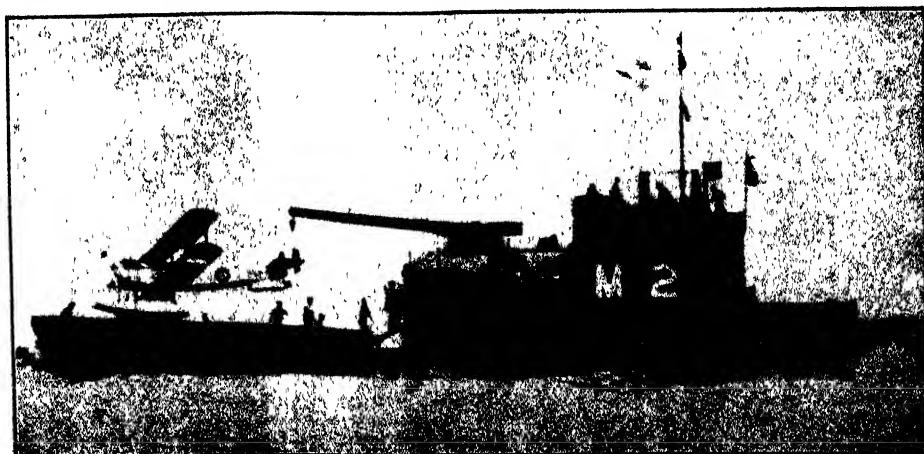
A Novel Test Bed

THE *London Aeroplane* publishes a brief description of an entirely novel engine test bed. An engine test rig requires dynamometers, instruments of every variety, an observer's room, et cetera. When testing engines in full flight it is almost impossible to carry all the apparatus required. On the other hand, in ground testing it is difficult to reproduce the actual conditions of flight where air is flowing at high speeds past the engine and propeller, particularly when the horsepower is very high.

The Dornier Company of Germany has met the situation in an ingenious fashion by mounting the engines to be tested in a hydroplane capable of over 75 miles per hour. The floating test bed provides every facility for testing the two huge Jupiter geared engines with tandem disposition of engines and propellers. In particular, the new apparatus should provide much useful engineering data on the efficiency of tandem airscrews.

A Submarine Aircraft Carrier

THE submarine has already attained an astonishing degree of size and independence of action, and is a foe dreaded by the largest battleship. It becomes a still more formidable war vessel, when it can carry an airplane on board. Our photograph is the first released of the British submarine *M-2* on which what was formerly a 12-inch gun turret is now used as an airplane hangar. The seaplane is pulled out of its hangar by man power, slides along the deck and is ready to rise from the water in a very short time.



International News

The former 12-inch gun turret on the British submarine *M-2* is now used for the hangar of a seaplane. The latter can be placed in action quickly



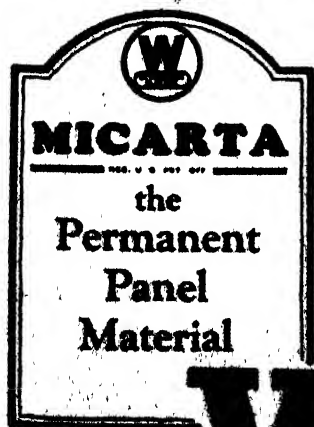
The Beauty of **MICARTA**

RADIO sets are judged by their appearance as well as by their performance.

Micarta—with its high dielectric strength and low power loss—not only builds efficiency into a radio set, but it also adds permanent beauty. Walnut burl, walnut grain, ebony, and mahogany finishes of Micarta enhance the appearance of any radio set—no matter how artistic the design.

Micarta machines easily. The drill and the saw never chip it.

Micarta radio parts of every design—in any quantity—can be obtained from—



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Industries From Atoms

A Department Devoted to the Advancements Made in Industrial and Experimental Chemistry

Accelerated Test of Paint Checks Exposure

ACCELERATED tests for determining in advance the life of a paint film and its ability to protect metal surfaces beneath it have frequently been proposed,

were passed into the box through wash bottles, to insure a slow but steady current, and a small quantity of steam was admitted to keep the atmosphere within the box always very moist, but not sufficient to raise the temperature materially. The panels

veloped the same relative showing, but in some cases the companion panels seemed to wear equally well for ten years before the difference in favor of the ready-mixed red lead panels became apparent. The searching nature of the accelerated test brought out differences in three or four days that in some instances were not disclosed in the time test until ten years had elapsed. In no instance has any contradiction in the final results been noted, except the slight difference in the panels containing 20 and 30 percent of kauri varnish."

Uncle Sam Extends Helium Production

THE final closing of a contract with the Amarillo Oil Company of Amarillo, Texas, which, it is thought, will greatly increase the available supply of helium, the rare non-inflammable gas required for the operation of dirigibles, is announced by the Bureau of Mines. Under the terms of the contract, the Bureau will undertake the extraction of the helium from natural gas from the company's leases on the Cliffside Structure in Potter County, Texas, at a new helium plant to be constructed by the government at Amarillo.

Rubber Paint

PAINT made of rubber, which when applied to a surface would give a film possessing the desirable properties of rubber, has been the aim of many "inventors," and even the subject of several patents. There are several reasons why the use of rubber hydrocarbon as such for paint has been impractical. Solutions of rubber in organic solvents, so-called "cements," are very viscous and it is necessary to use low concentrations. Dilute solutions—say 2 to 5 percent—are difficult to handle as far as brushing, spraying, dipping, et cetera, are concerned.

After a film has been deposited it is not satisfactory, owing to its tacky nature, until it is vulcanized. This could be made an air-curing process, but at least several days would be required. Small objects could be cured in heaters, as is now done with baking paints, but such a process would limit the use of the paint too closely. Even were it possible to obtain a smooth, even coat wherever desired, there would be difficulty in obtaining a proper cure, as frequently considerable trouble is encountered in vulcanizing films deposited from a cement.

Recently, there has been perfected in the laboratories of the Goodrich Rubber Company, a method of modifying the properties of rubber hydrocarbon by means of a change other than vulcanization. A series of products ranging from a tough, horny substance to a brittle, pulverizable material resembling shellac is made available by this treatment. The hydrocarbon is known as thermoprene, and its promising properties as a basis of paint are described by Harold Gray, of the Goodrich Rubber



In the research laboratories of the Westinghouse Electric and Manufacturing Company, much glassware is necessary. Above is shown Christopher Kirwer, expert glass blower, who turns out many forms of complicated apparatus

and on the basis of such tests many statements as to the particular value of particular paints have been made. It is very seldom that such a quick test is compared with definite exposures of similar samples to the weather and when such a comparison is made and results in a complete check between the two, one must be impressed. In 1913 Norman A. Dubois conducted a series of accelerated tests on structural paints and in four days reached conclusions as to the relative values of various formulas for compounding protective coatings. At the same time similar samples of paint were applied to panels which were exposed to the air and 11 years later these exposed panels confirmed accurately the conclusions drawn from the four-day test. The close check between the two results confirms the theory as well as the practice employed by Dubois. In describing his work in 1913 in *Industrial and Engineering Chemistry*, Dubois said in part:

"The problem is a physical one rather than a chemical one, and a comparison of paint films as to their relative obstruction to the diffusion of gases will tell more regarding their value as protection against corrosion than a study of inhibitive action of their pigments."

To prove this theory, panels painted with the various coatings under consideration "were exposed in a closed box with a glass front in order that the conditions could be carefully watched. Oxygen and the corrosion-accelerating gases in the atmosphere

were examined from day to day, and removed when it was judged that further exposure might obliterate the truths for which we were seeking. The test was completed in four days. Sulfur dioxide was the principal gas used."

The exposure test of the same paints was described by Edward D. Gregory in a recent issue of the same publication, who says in part:

"A portion of each of the samples submitted to Dubois was sent to one of the large railroads of the east, and their test department painted panels of many combinations and exposed them on the roof of one of their terminal buildings. These panels have been subjected to weather conditions since the first week in March, 1914. The management of the road has permitted photographs of these panels to be taken and has invited engineers from the railroad and other groups to make personal inspection, when the panels had been exposed 11 years and five months.

"The result of this time test bears a very close relation to the accelerated test of Dubois and it is one of the few instances where a time test of elaborate character has been linked with a preliminary accelerated test.

"The accelerated test of Dubois showed that every panel primed with pure red lead and finished with a black paint withstood the test less well than the companion panel where a special ready-mixed red lead was used as primer. The time test has de-

NOW ALL SIXES

**DODGE BROTHERS, INC. ANNOUNCES FOR
ITS GRAHAM BROTHERS TRUCK LINE**

6 Cylinder Engines

IN ALL SIZES AND TYPES

4 Wheel Brakes

ON ALL SIZES AND TYPES

ECONOMY
as always

LOW PRICES
as always

DEPENDABILITY
as always

***665**

MERCHANTS EXPRESS
110" wheelbase

***775**

COMMERCIAL TRUCK
120" wheelbase

***995**

1½-TON — 130" wheelbase

***1065**

1½-TON — 140" wheelbase

***1345**

1½-TON — 150" wheelbase

***1415**

1½-TON — 165" wheelbase

***1595**

2½-TON — 150" wheelbase

***1665**

2½-TON — 165" wheelbase

Chassis f.o.b. Detroit

YOU may now have all the performance advantages of 6-cylinder engine and 4-wheel brakes on any size or type of Graham Brothers Trucks.

Six cylinder power . . . Six cylinder speed . . . Six cylinder operating ease . . . The snap of 6-cylinder acceleration and the safety of 4-wheel brake deceleration . . . Four speed transmission on all 1¼,

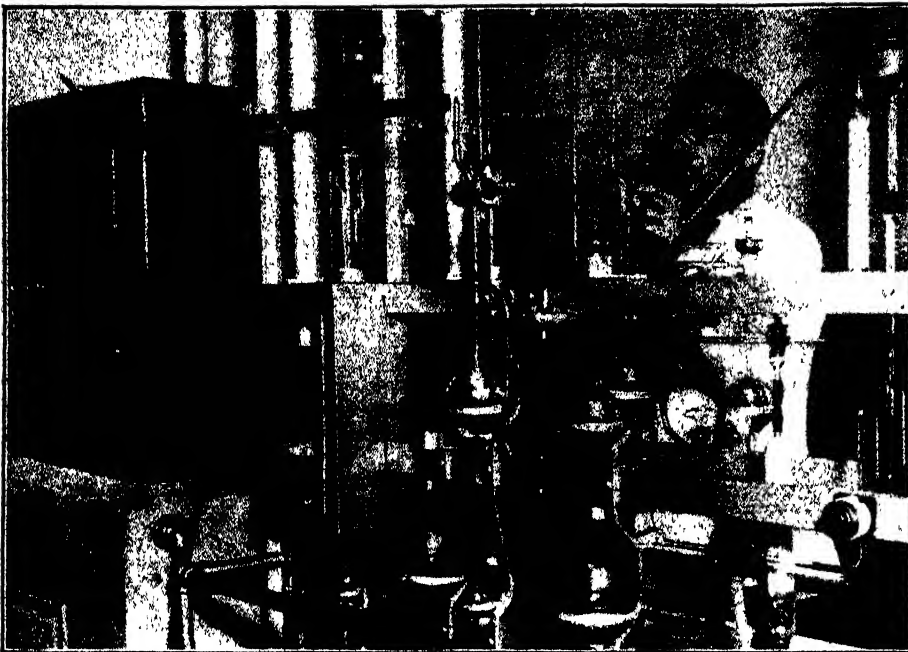
1¾ and 2½-ton models. See these trucks today. Let your local Dodge Brothers Dealer tell you of the many additional advanced features. We have the exact size and type for your business. Drive one. Compare them—for price, for value, for appearance, for their ability to do your job and make you money—with any truck you ever considered good value.

Graham Brothers Trucks are built in the chassis sizes that meet 95% of all hauling needs

GRAHAM BROTHERS TRUCKS

BUILT BY
TRUCK DIVISION OF
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SOLD AND SERVICED
BY DODGE BROTHERS
DEALERS EVERYWHERE



F and A

Two grams of radium, used at the City Hospital in New York City, are kept in 40 glass tubes which are shielded by six inches of lead, and kept in the safe shown at the left. Photo also shows Dr. A. Norman, of the hospital staff

Company, writing in a recent issue of the publication of *Industrial and Engineering Chemistry*.

"The outstanding point of interest to the paint chemist," says Dr. Gray, "is that the concentration of thermoprene in the solvent can be as high as 10 to 20 percent and still be within the range of good brushing products. The chief difference between thermoprene paint and those previously made with a raw-rubber vehicle is that the former resembles a lacquer in that it needs no vulcanizing or curing operation.

"The resistance of the thermoprene paint to chemical action by acids, alkalies, corrosive gases and chemicals is very good. It shows a remarkably low permeability to moisture. Any paint to be of value must adhere firmly to the surface it covers. The high degree of adhesion of the new paint is one of its most important properties. It is practically impossible to separate the film from the underlying surface without actually cutting it.

"Another rather unusual feature of the paint is its resistance to sudden temperature changes. In one series of experiments

the films (on steel) were cooled in an ice-salt bath and then put on a hot plate at 115 degrees, Centigrade. After 15 minutes on the hot plate the panels were plunged into the ice water again. This cycle was repeated 10 to 15 times with no apparent effect on the films.

Any desired pigment can be used in the paint and any color except a pure white can be obtained. The amount of pigment can be varied widely. The possible range extends from no pigment at all to as high as 250 to 300 volumes of pigment to 100 volumes of thermoprene. The practical range is yet to be determined. Good results are obtained with 70 volumes of pigment. Color may be imparted by organic dyes, using a white pigment as the filler. A very wide range of oils and softeners can be used. In some cases where a baking paint is desired, drying agents may be used.

"The paint should probably be classed as a lacquer, since a solvent is used which does not remain as a part of the film. In general, the ordinary rubber solvents are used—such as gasoline, toluene, benzene, carbon tetrachloride, turpentine, kerosene, et

cetera. The solvents are varied according to the use for which the paint is intended—brushing, spraying or dipping."

Dirt by the Tablespoonful

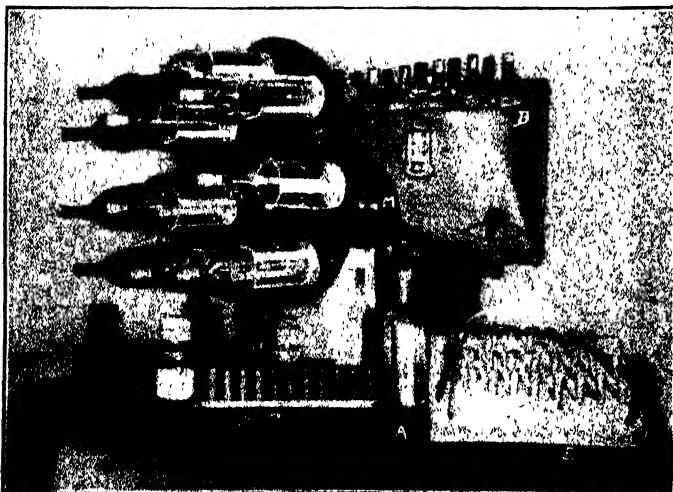
HOW much dirt do you take with your daily air? The answer varies with the location in which you pass your days, and despite its reputation as the "Smoky City," Pittsburgh, Pennsylvania, is not the home of the champion dust inhalers.

Howard C. Murphy recently told the American Society of Heating and Ventilating Engineers that St. Louis leads all of the cities of the country in smoke production, with Cincinnati a poor second, and Pittsburgh, the former unholy example, in third place. St. Louis is making a real attempt to cut its smoke. Schools have been established to show home owners and apartment house superintendents the proper method of firing the soft coal that is universally used in the city. It is estimated that proper firing of domestic furnaces and boilers will reduce the smoke by 80 percent. Pittsburgh has worked for several years and results are apparent when the "Smoky City" drops to third place on the list.

Mr. Murphy figures that the average St. Louisan inhales more than a tablespoonful of dirt every day, while the New Yorker takes a teaspoonful. His figures for the dust particles per cubic foot of air based on a test of several years' duration are as follows: St. Louis, 17,600; Cincinnati, 16,770; Pittsburgh, 16,100; Detroit, 15,300; Cleveland, 13,840; Louisville, 13,340; Buffalo, 12,350; Baltimore, 11,980; Milwaukee, 11,460; Toledo, 10,700; Columbus, 10,160; Philadelphia, 9,880; New York, 9,700; Kansas City, 9,700; Atlanta, 9,460; Minneapolis, 8,470; Des Moines, 8,370; Washington, 7,800; Denver, 6,740; New Orleans, 6,600; San Francisco, 6,580; Boston, 5,860.

The *Gas Age Record* points out the lack of regulations controlling the purity of air in our cities, all of which carefully control food and water supplies. "This seems astonishing when one thinks of the important part the respiratory function plays in sustaining human life," says this magazine, editorially. "The summer death rate has been decreasing steadily, but the winter death rate is steadily increasing. Present knowledge points to air pollution as one of the contributing causes. Besides carrying germs, these smoke particles cause a foggy

(Please turn to page 173)



The photographs above and to the right show apparatus for determining the amount of carbon monoxide in the air. Samples of the air are collected in bottles and taken to the laboratory. Here, by means of the equilibrator



shown, a blood reagent is exposed to the collected gas. Then the reagent is treated with a bleaching solution. The resulting color, compared with color charts, denotes the amount of carbon monoxide in the tested air



Don't fool yourself

Since halitosis never announces itself to the victim, you simply cannot know when you have it.

The ring came back -with a bottle!

*Today, halitosis is inexcusable
People who offend deserve
no sympathy*

A WOMAN we know took a direct means to settle a matter which she couldn't bring herself to talk about.

She returned the engagement ring—with a bottle. A bottle of Listerine. It carried its own implication.

Brutal? Perhaps. But those who today offend by halitosis (unpleasant breath) deserve not too much consideration. They ignore the facts about it (see below). They refuse to suspect themselves. They fool themselves.

Nice people, fastidious people, people who consider others, recognize the constant risk of offending this way, and keep themselves on the polite and popular side by using Listerine. Every morning. Every night. And between times when necessary—especially before meeting others.

Keep a bottle handy in home and office for this purpose.

Listerine ends halitosis instantly. Being antiseptic, it strikes at its commonest cause—fermentation in the oral cavity. Then, being a powerful deodorant, it destroys the odors themselves.

If you have any doubt of Listerine's deodorant properties, make this test: Rub a slice of onion on your hand. Then apply Listerine clear. Immediately, every trace of onion odor is gone. Even the odor of fish on the hands yields to it. Lambert Pharmacal Co., St. Louis, Mo.

READ THE FACTS

1/3 had halitosis

68 hairdressers state that about every third woman, many of them from the wealthy classes, is halitoxic. Who should know better than they?

**Have you tried
the new Listerine
Shaving Cream?**

Cools your skin while you shave and keeps it cool afterward. An outstanding shaving cream in every respect.

LISTERINE

-the safe antiseptic

Strays From the Ether

A Monthly Review of the Progress Made In All Branches of Radio Communication

Oil-Cooled Tubes

OIL-COOLED thermionic tubes used to generate the extra high-frequency oscillations are employed on the main

"Amateur stations must use circuits loosely coupled to the radiating system or devices that will produce equivalent effects to minimize key impacts, harmonics and

or for testing purposes. This restriction does not apply to communication with small pleasure craft such as yachts and motor boats holding limited commercial station licenses which may have difficulty in establishing communication with commercial or Government stations.

"Amateur stations are not authorized to broadcast news, music, lectures, sermons or any other form of entertainment.

"No person shall operate an amateur station except under and in accordance with an operator's license issued to him by the Secretary of Commerce."

Tests Effects of Sunspots on Radio

FUTURE radio engineers may be able to look at the sun through a telescope and then tell how the presence or absence of spots will affect the transmission of radio waves, as a result of an investigation now under way with the co-operation of physicists and astronomers.

There has just been installed in the Harvard Astronomical Laboratory, under the direction of Dr. Harlan T. Stetson, professor of astronomy at Harvard, apparatus to study the relation of spots and radio. Greenleaf W. Pickard, Boston radio engineer, designed the apparatus, and installed it for use in connection with studies which he has been carrying on for several years. Each day the sun is photographed to give the size and number of spots.

"It is not yet possible to say whether or not a combination of radio data with observation of the sun can ever be used to predict earthly weather conditions," said Dr. Stetson. "However," he continued, "observations are beginning to make us feel confident that there is a direct connection between conditions in the solar atmosphere and certain atmospheric disturbances on



Underwood and Underwood

C. Francis Jenkins recently demonstrated his latest radio "movie" receiver in Washington, D. C., before the members of the Federal Radio Commission. The receiver, shown above, reflects the moving image by means of a mirror

circuits of the Marconi beam transmitters in preference to water-cooled tubes, because in short-wave work oil is easier to handle. Also, it is itself an insulator.

Amateur Regulations

THE Federal Radio Commission has established the following regulations governing the licensing and operation of amateur radio stations:

"Amateur radio stations are authorized for communication only with similarly licensed stations and on wavelengths or frequencies within the following bands: 401,000 to 400,000 kilocycles (0.7477 to 0.7496 meters); 64,000 to 56,000 kilocycles (4.69 to 5.35 meters); 30,000 to 28,000 kilocycles (9.99 to 10.71 meters); 16,000 to 14,000 kilocycles (18.7 to 21.4 meters); 8000 to 7000 kilocycles (37.5 to 42.8 meters); 4000 to 3500 kilocycles (75 to 85.7 meters), and 2000 to 1500 kilocycles (150 to 200 meters).

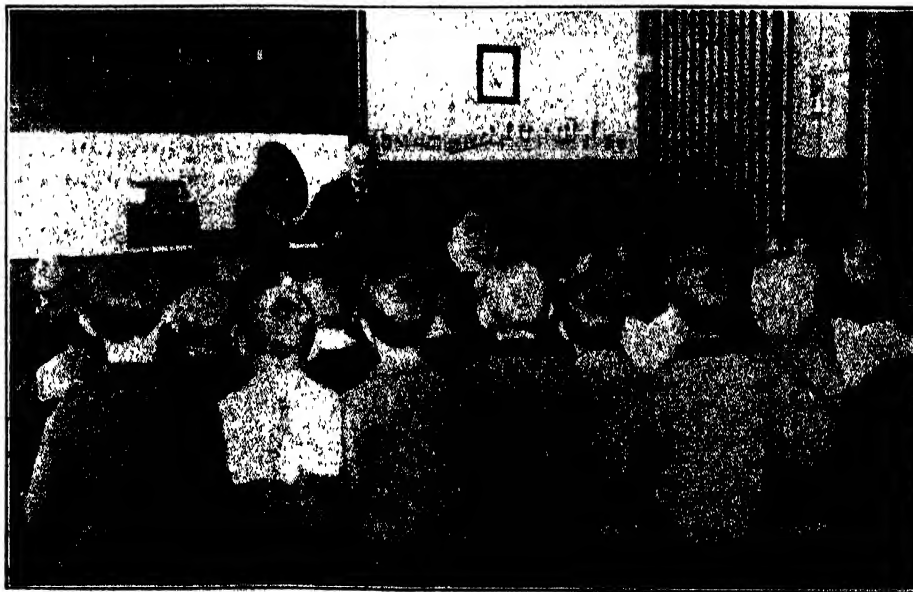
"These stations may communicate at all times unless interference is caused with other radio services, in which event a silent period must be observed between the hours of 8 and 10:30 P.M., local time, and on Sundays during local church services.

"Amateur radio telephone operation will be permitted only in the following bands: 64,000 to 56,000 kilocycles (4.69 to 5.35 meters); 3550 to 3500 kilocycles (84.5 to 85.7 meters), and 2000 to 1715 kilocycles (150 to 175 meters).

"Spark transmitters will not be authorized for amateur use.

plate supply modulations. Conductive coupling, even though loose, will not be permitted, but this restriction shall not apply against the employment of transmission line feeder systems to Hertzian antennae.

"Amateur stations are not permitted to communicate with commercial or Government stations, unless authorized by the licensing authority, except in an emergency



Wide World

These youngsters of the class of music at the Christburger School in Berlin are receiving their instruction by means of the radio receiving set shown

the earth. It seems not unlikely that with the further study of the bearing of sunspots upon radio reception it will be possible to make allowances for the solar disturbances and by so doing discover more closely than ever before the correlation of radio reception with temperature, pressure and other meteorological phenomena.

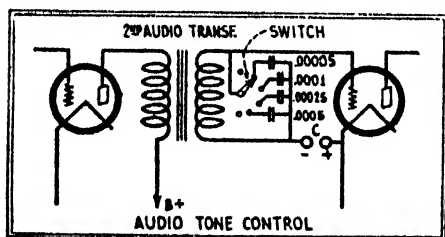
"Just what happens on the earth when a sunspot appears on the side of the sun towards us is not fully known. It is believed that electrified particles discharged from the disturbed region on the sun, hurling through space, bombard the upper atmosphere of the earth and are responsible for an increased ionization of the latter which is responsible for the modification of the intensity of the radio waves."

The station from which the signals will be sent, which are to be measured at the Harvard laboratory, is WBBM, Chicago. The apparatus which automatically records signal strength, as received in Cambridge, is carefully calibrated each day and makes it possible to record the measurement in absolute units of electrical intensity.

Dr. Stetson explained that the apparatus was so designed as to measure the intensity of the carrier wave and would scarcely be affected at all by super-imposed modulations caused by the broadcasting of music. —Science Service.

Tuning Audio Transformers

THERE never will be a universally ideal amplifier or loudspeaker, because all ears and musical tastes do not run alike. Some prefer an accentuated sharpness or crisp reproduction; others prefer a mellow, deep rendition. Others—and they are rare—strive for a happy medium. For-



Tone control with fixed condensers

unately, however, it is possible with the aid of small, inexpensive mica fixed condensers, to obtain almost any musical quality from the usual radio set.

Transformer coupling will usually give sharp, crisp reproduction. If that kind of reproduction is desirable, then the transformer-coupled amplifier should be left alone. Slight modification of "B" and "C" voltages may result in accentuating the sharp, crisp effect even more, if desired.

When it is preferable to adjust the sharpness or mellowness of radio rendition in accordance with the subject matter of the program, such as crisp reproduction for speech and mellow reproduction for orchestral selections, the arrangement shown in our sketch may be followed. This comprises a collection of condensers arranged in steps of capacity and shunted across the secondary of the second audio transformer.

For Television Experimenters

WITH the development and introduction of the Kino-Lamp or neon tube for television reception, and the Foto-Cell for television transmission, the Raytheon



... over the miles and years

THE history of Hyatt Quiet Roller Bearings... during the last 37 years... records years of unprecedented savings in attention and replacement.

Millions and millions of automobile miles reflect Hyatt's unparalleled operating stamina... uninterrupted performance... unwavering satisfaction!

As in the automobile, at various strategic points in industrial, railroad and farm equipment are Hyatt Roller Bearings... selected because of the silent, efficient manner in which they harmonize with the objectives of engineers.

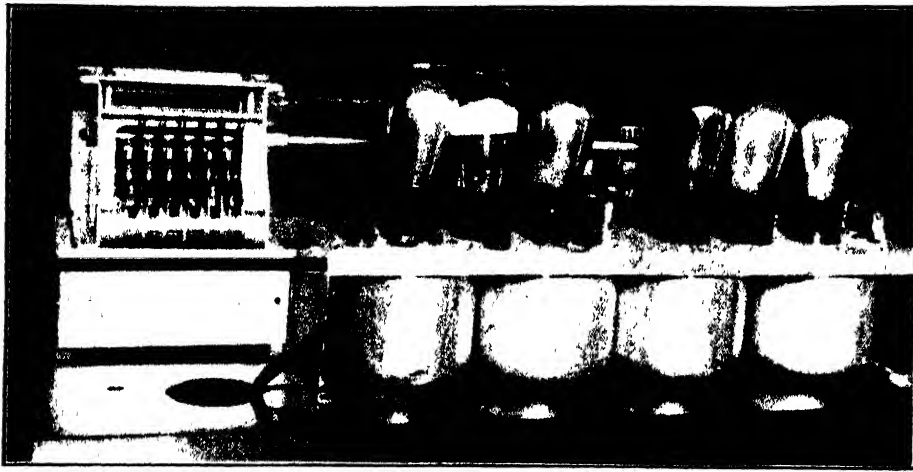
Selected, too, because of the faithfulness with which Hyatt quality preserves and protects the reputation of those products in which Hyatts are used.

HYATT ROLLER BEARING COMPANY

Newark Detroit Pittsburgh Chicago Oakland

HYATT
ROLLER BEARINGS

PRODUCT OF GENERAL MOTORS



F and A

By means of this special radio receiver, programs from various broadcasting stations are received by the simple process of pressing the proper lever

organization has launched into an extensive campaign of research and special production in co-operation with television experimenters.

"We do not assume for a single moment that television has arrived at the commercial stage or anything even approaching such refinement," stated D. E. Replogle. "However, we do believe that the time is ripe for television experiments both at the transmitting and the receiving end, on an extensive scale. Therefore, as headquarters for gaseous tubes of all kinds, we are prepared to co-operate with experimenters and others in the development and production of special tubes for television requirements.

"Our research staff, headed by C. G. Smith, inventor of the Raytheon tube and its predecessor, the S-tube, has had long experience in gaseous conduction. Experiments have been conducted with every conceivable gas, electrode, spacing, arrangement, insulator and so on. We have studied the effects of gas pressure until today we can produce tubes of a given starting voltage, luminosity, responsiveness, and so on.

"We therefore wish to co-operate with television experimenters in the development of the necessary neon tubes and photo-electric cells of regular or special design, to the end that this young art may receive the maximum co-operative effort of amateurs in repeating the spectacular development of radio broadcasting."

DX Still With Us

THE DX "hound" has not disappeared by any means, in the opinion of Hal P. Shearer, general manager of Splittorf Radio Corporation.

Upon returning to Newark, New Jersey, from a several weeks' tour of the mid-west and far west, Mr. Shearer stated that he is inclined to the belief that the distance-loving fan is "even worse than ever." He quickly explained that he did not mean to hold this against the radio-set owner who loved to sit up nights and tune in the far-distant stations. On the contrary, he believes this to be a good thing, adding, "for those manufacturers whose sets are capable of picking up distant stations with any regularity."

"On the west coast," said Mr. Shearer, "a set must be good to satisfy most of the fans. Even with the chain broadcasting of today it is necessary for the west-coast people to reach out for dis-

tance to satisfy themselves entirely, and I do not intend this as a criticism of west-coast programs. The feeling is still there for the getting of a station some 2000 miles away. There is no question about it—so far as DX is concerned we are just as much interested in it today as we were in the years-ago of radio. Of course, there is quality with distance now on a good set, but the lure is the same old lure—thank goodness for that!"

Soundproof Room for Testing Radio Receivers

IN testing the quality of radio reproduction, absolute quiet must prevail, a condition which is difficult to obtain in the modern factory. To this end Frank A. D. Andrea built for his engineers a soundproof room of unique design. This room is in reality a room within a room. It has double walls, double ceiling and a double floor. The space between is filled with wood chips. The room is supported on cork to remove the vibration of the building. The inner door is suggestive of the entrance to a refrigerator.

The soundproof room has among its equipment oscillators, amplifiers, radio receivers and measuring equipment of several kinds. It is easily apparent that in a soundproof room of this sort development work progresses to advantage in all phases of radio research requiring the most delicate measurements and testing for absolute quality.

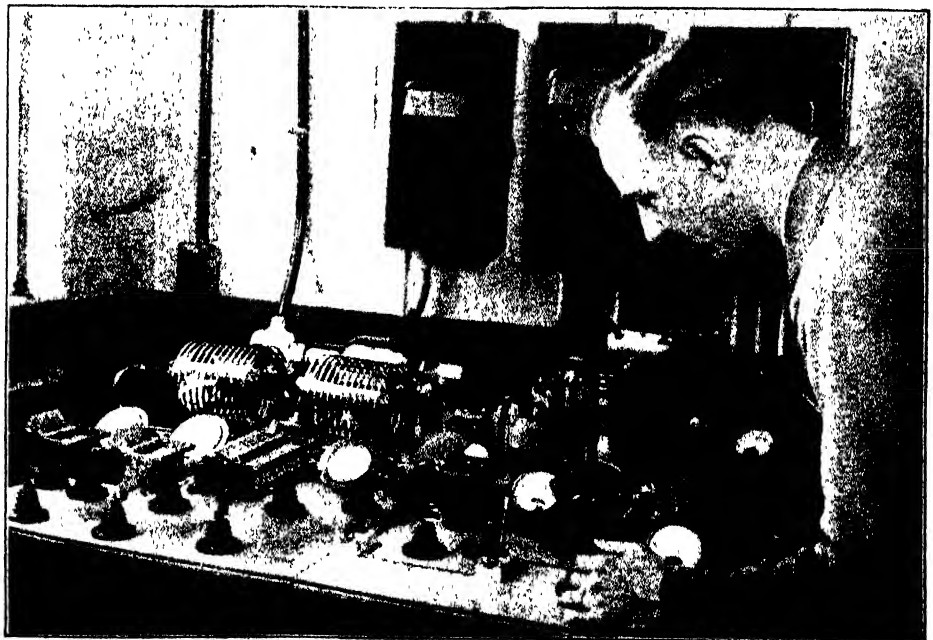
Increasing Efficiency

MANY radio owners run their receivers like a good many automobile owners run their cars—at very low efficiency. Running a car at very low efficiency is often inexcusable because in most cases the trouble lies in the fact that minor adjustments have been neglected. An improperly adjusted carburetor or poorly seated valves will cause considerable loss of power and the formation of carbon which will soon further decrease the efficiency of the motor. In most cases a simple adjustment which could be made in a few minutes at very little cost would increase the efficiency tre-



F and A

Commander E. F. McDonald, noted explorer, demonstrating the automatic radio receiver which he has designed. There are no dials in the ordinary sense of the word, tuning being accomplished by the switches



Underwood and Underwood

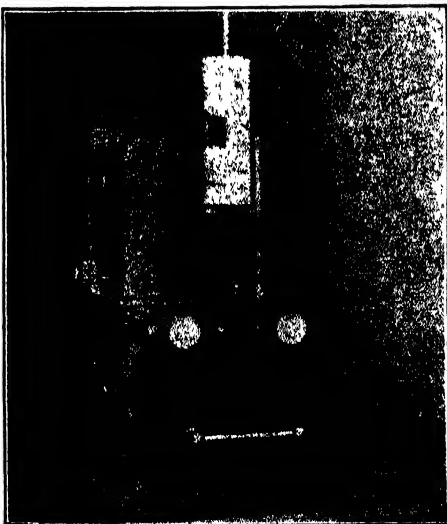
The new short-wave transmitter installed at WABC, Richmond Hill, Long Island. William Schick is shown tuning the set to its wavelength of 58.5 meters

mendously, result in a great saving of gas and reduce the necessity of repair bills.

In radio amplification it has been common practice to use a "B" or plate voltage of 90 volts without a biasing battery, and while this results in maximum amplification, it is wasteful of battery current and tone quality. A decrease of this voltage to 67.5 or even 45 volts, or the addition of a "C" battery in the radio-frequency stages will result in a large saving of "B" battery current, together with improved tone quality on local stations. Two CX-301A



Above and below are two views of the transmitter for photographs that was invented by Austin G. Cooley of New York. The system is said to be very simple in principle, and it has been announced that kits for constructing adapters for receiving the pictures on broadcast sets will soon be available



tubes as radio-frequency amplifiers require 12 milliamperes plate current with 90 volts "B" voltage, 7 milliamperes with 67.5 volts and only 3.4 milliamperes when the voltage is reduced to 45 volts. The use of lower plate voltages will often more than double the service obtained from dry cell "B" batteries, and will result in securing quiet, hum-free performance from "B" eliminators, especially those having limited output.

Another distinct advantage of the lower "B" voltages for radio-frequency stages is the fact that oscillation is much easier to control, thus resulting in more stable operation of the receiver and better tone quality.



YOUR TELEPHONE, PRODUCT OF 28 COUNTRIES ~ ~ ~ ~

SILK worms are busy in far-off Japan. Native Malaysians are burrowing into tin-laden hills "east of Suez." High upon the Andes, the descendants of the Incas are digging for copper. *All to help make your telephone!*

To the Western Electric factories come raw materials from the far corners of the earth as well as from "just around the corner." Out of nineteen of the world's distinctly different products, American ingenuity has shaped the telephone.

But, if it takes a world of material things to make your telephone, think of the worlds of other things that play no little part.

The skill of the magnet coil winder. The dexterity of the sure-handed punch-press operator. The expertness of the keen-eyed laboratory worker. The guiding mind of the engineer. The vision of the manufacturing executive.

Of all these your telephone is made.

Over 500 different occupations are represented in the great army of Western Electric workers; an army which—while it directly carries on the triple responsibility of purchasing, manufacturing and distributing for the

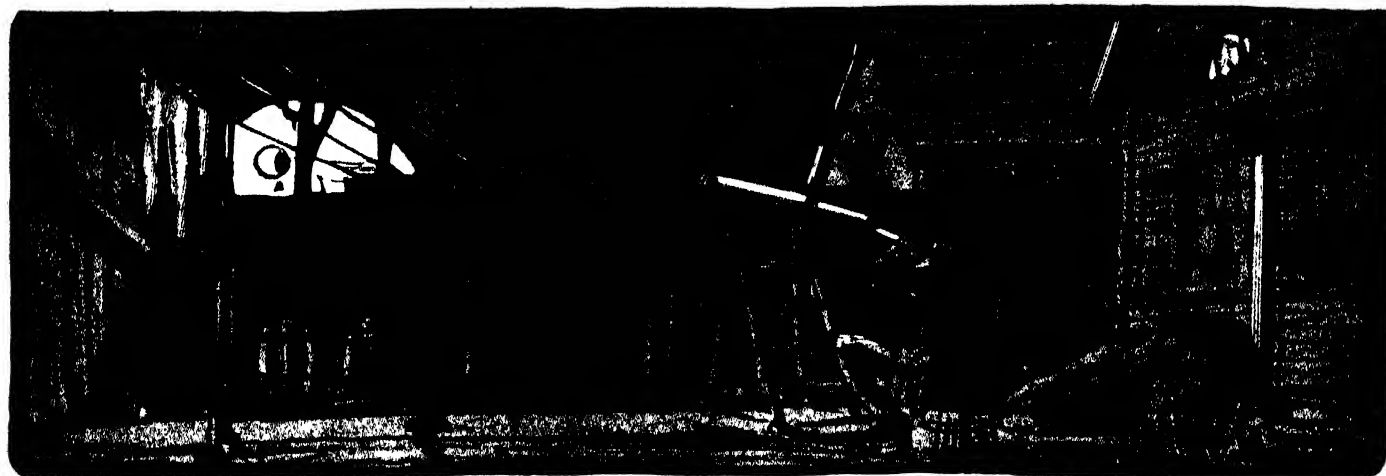
Bell System—indirectly "carries on" for you.



Western Electric

Purchasers...Manufacturers.. Distributors

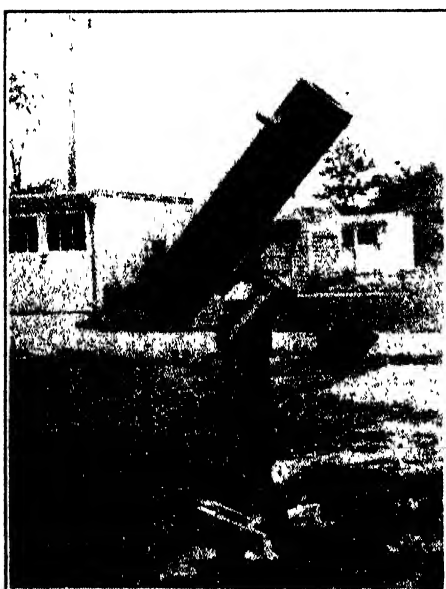




The Back Yard Astronomer

A Department Devoted to Interests of the Amateur Telescope Maker

"A TELESCOPE ought to have a sufficiently rigid mounting," writes an amateur in Los Angeles, "so that it will not vibrate when a trolley car crosses a bridge in San Francisco." Well said. We have



Mr. Towson's telescope—rigid

seen a number of flimsy mountings which can not possibly be held steady. Sheldon K. Towson, 16215 Fernway Road, Shaker Heights, Cleveland, Ohio, sends in a description of his telescope which has what we call a sufficiently rigid mounting.

"The enclosed photograph," Mr. Towson writes, "shows a mounting which I believe is as simple an affair as it is possible to assemble, requiring machine work only for four bushings and the two axes. The base, pillar and 45-degree 'Y' branch are now permanently mounted on a concrete foundation. The rest of the mounting is temporary and will be replaced by a Ford axle rigging.

"The six-inch mirror, being my first attempt, has many faults; it is scratched, the parabola is questionable, and the silver does not reach the edge, but it is good enough to separate the components of

Epsilon Lyrae and therefore serves to prevent undue haste while I polish an eight-inch mirror for the same mounting."

One of the most elaborate telescopes thus far made from the instructions contained in "Amateur Telescope Making," is the product of J. A. Johnson, Opt. D., 322 Patterson Building, Fresno, California. The description, sent in by the maker, runs as follows:

"I am enclosing some pictures of a 10-inch telescope which I have just completed. It is equipped with a clock and setting wheels, with lights over the circles to read



Dr. Johnson's elaborate arrangement

at night. I made patterns and had all the parts cast. The tube is 12 inches in diameter and six feet, six inches long. The mirror is 72-inch focus.

"The gears of the clock are standard stock. After making four different governors, I finally got one that is sensitive enough and it works perfectly. It took me 1800 hours to make it. I worked every night from 7 P.M. until 11 P.M. Telescope making is some hobby.

"The telescope house is 8 by 8 feet and 8 feet high to the plate. The telescope rests

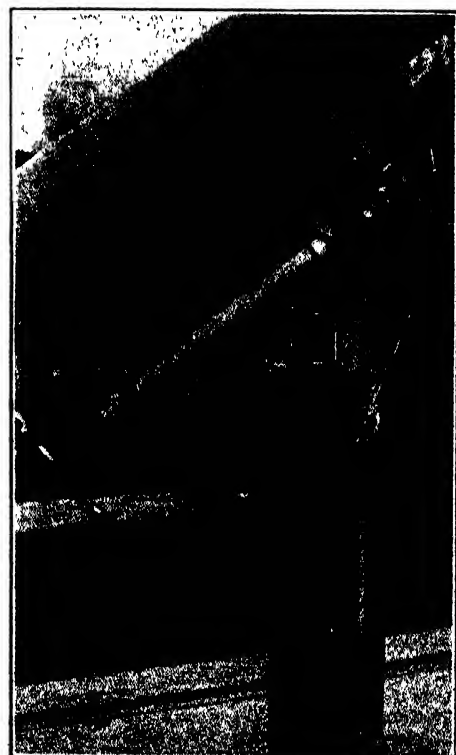
on a concrete base with a concrete floor nine feet square. The house is mounted on four small flange wheels which run on a light iron rail track.

"Your book on telescope making was a big help."

Some months ago we stated that a club of amateur telescope makers was being organized in Chicago. Thus far, however, no very tangible results have been reported from Chicago, but Philadelphia has now beaten Chicago to it. The following letter from Glenden J. Dunlap reaches us on the letter head of the local Y.M.C.A.:

"A club has recently been organized at the Central Y.M.C.A., for the purpose of giving instruction in the making of telescopes and in astronomy. The man in charge is Mr. G. H. Lutz, a civil engineer who made the world's first permanent tele-

(Please turn to page 176)



Detail of the axes and clock

Industries From Atoms

(Continued from page 166)

condition, technically known as "smog," that is making many of our cities rival London. Many students of air pollution believed at one time that factory stacks were the primary cause of smoky conditions and air pollution. Experience has shown, however, that it is the improper combustion in domestic heating plants that causes the major part of the smoke. There are thousands of these to every one factory stack."

Protective Coatings For Food Containers

IN order to prevent the loss of color of certain canned fruits, the so-called enameled cans (or lacquered cans as they are sometimes termed) have been developed. This enamel prevents the general corrosion of the inside of the can, says a bulletin of the National Canners Association, but the lacquer is not entirely continuous and cans so treated perforate to a greater extent than plain ones. Enameled cans have been used to an increasing extent for more than 15 years, not only with red fruits, but also with some of the more acid vegetables that have a pronounced flavor of their own, such as beets, and pumpkin. The enamel used for these products cannot be used with certain vegetables that have a more delicate flavor, such as asparagus and string beans, because it imparts an objectionable flavor to the product.

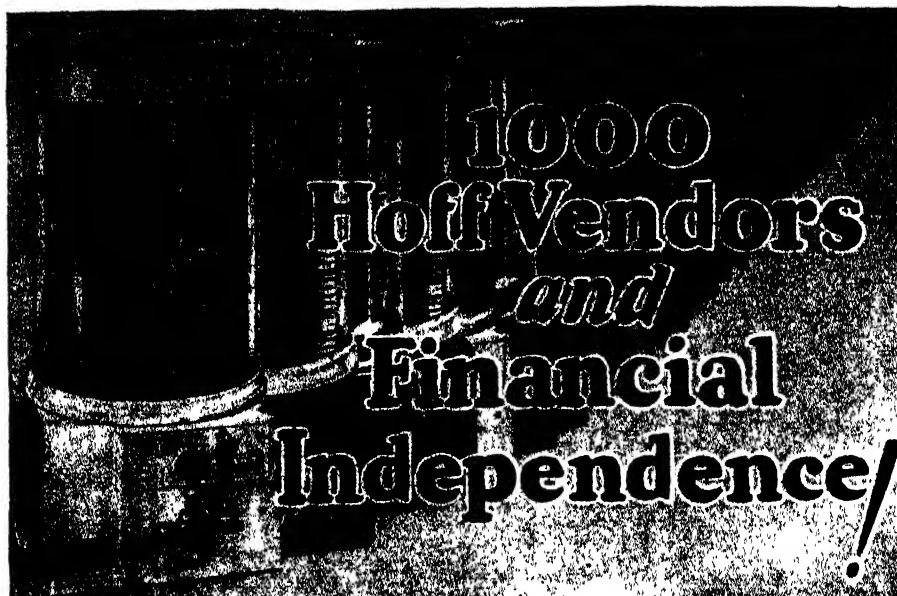
A special lacquer has been developed for products that have a tendency to form iron sulfide discoloration, especially corn. This special lacquer will not answer for acid products such as fruits, but has been found to prevent the iron sulfide discoloration for which it was developed and also to prevent the general tarnish to the inside of a can due to the formation of tin sulfide.

Chemists believe that the universal adoption of the lacquered can will follow upon the development of an entirely suitable lacquer. Recent experiments indicate that such a substance may become available from the development of synthetic resin lacquers. Excellent adhesive powers, extreme impenetrability and failure to impart taste or odor to foods are claimed for some of these new products of chemical synthesis now in the experimental stage.

New Sulfuric Acid Catalyst

THE use of platinum as a catalyst for the oxidation of sulfur dioxide gas to sulfur trioxide for the manufacture of sulfuric acid by the contact process is one of the commonest of industrial applications of catalysis. The precious metal is spread in a very finely divided state on the surface of asbestos fibers or small lumps of fused magnesium sulfate. It is entirely satisfactory as a catalyst, the conversion of sulfur dioxide to trioxide running from 95 to 99 percent, the platinum being unchanged except when "poisoned" by impurities in the gas. While no platinum is used up in the process, the quantity required for a commercial unit is large enough to represent a considerable investment, which must, of course, be charged against the cost of the acid.

Therefore, the acid manufacturer is intensely interested in recent developments



AN UNUSUAL BUSINESS OPPORTUNITY

THE owner of a chain of vending machines is an independent business man whose duties are easy and pleasant, and who makes permanently, month after month and year after year, extremely high profits on a nominal investment. This statement is based on the experiences of more than 70 chain operators of Hoff Vending Machines, more than 30,000 of which are now in operation.

ENORMOUS DEMAND

The Hoff Vending Corporation of America, a division of a fifteen million dollar corporation, controls the exclusive franchise for distributing in penny vending machines two of the world's largest selling, best advertised, and most popular confections—a famous gum and a famous candy. Because of their enormous demand, monthly sales by Hoff vendors are large and steady. This demand is annually maintained and increased by enormous sums spent in advertising—during 1928 alone, more than \$7,500,000.

HIGH EARNINGS

Practical chains, consisting of from 200 to 1000 vendors, which can be easily serviced by one man or woman, show net earnings of from \$2,820.00 to \$13,800.00 yearly. No special experience or training is required. There is little to learn. Operating expenses are practically nil. The business can be run right from one's own home. The work is easy and pleasant, and most of it out of doors.

INTERESTING BOOKLET

Full details concerning the Hoff system of Penny Vending, including earnings of vendors, franchise details, cost of machines, cost of gum and candy, and the experiences of established operators, are gladly furnished on request. Write today for our new book "1000 Hoff Vendors and Financial Independence." It gives all the facts you need to know. Write today.

HOFF VENDING CORPORATION OF AMERICA

Division of General Vending Corporation

Dept. 13, 200 Hudson St., New York City

Hoff Vendors awarded gold medal, Sesqui Centennial Exposition, Philadelphia, 1926.

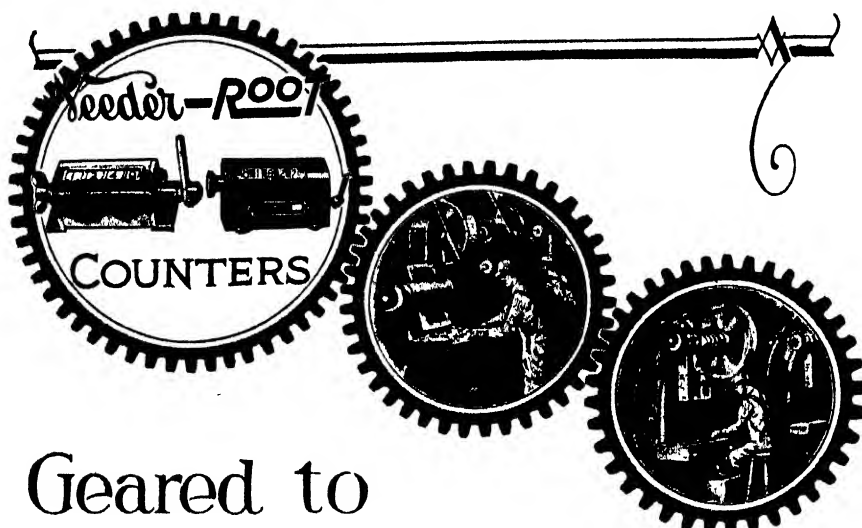


HOFF VENDING CORPORATION OF AMERICA, Dept. 13, 200 Hudson Street, New York, N. Y.

Please send your book, "1000 Hoff Vendors and Financial Independence" to the undersigned. I am looking for an unusual business opportunity.

Name

Address

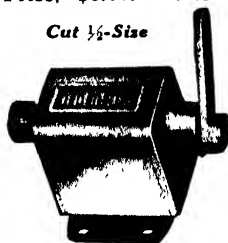


Geared to the Pace that PAYS

The pace that pays—in machine operation—is a little faster than “routine.” Set it at a standard rate and keep it up by *checking-up* with Counters. Step it up to a *higher* mark, as you develop a better machine or a better operator. Make the improvements register on a VEEDER-ROOT Counter.

Below is small Set-Back Ratchet Counter, which indicates one for each throw of the lever, moving through an angle of 45 degrees. Reset to zero from any figure by turning knob. Price, \$6.00. With

Cut 1/2-Size



lock and key to prevent tampering with record, \$2.00 extra. Also furnished in a Revolution Counter. Write for our *green book* of Counters for all machines.

Veeder-ROOT INCORPORATED
HARTFORD, CONN.

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which have brought the announcement of a satisfactory substitute for platinum which can be made at a much lower investment. A catalyst developed by the Monsanto Chemical Works, St. Louis, Missouri, is described by Dr. L. F. Nickell in a recent issue of *Chemical and Metallurgical Engineering*.

“Essentially,” said Dr. Nickell, “these new catalysts consist of complex vanadium silicates and give compact masses of high catalytic activity. The complex vanadium silicates can be used as such, or they can be diluted with various inert substances of any particular size. In either case, they exhibit an exceptionally high activity, showing conversions of SO_2 to SO_3 of 97 percent to 98 percent and even above, which conversions are maintained at usual commercial loading rates. The mass will even stand a large overloading.

“Aside from greatly decreased cost as compared to platinum catalysts, the great advantage of these new catalysts in sulfuric-acid manufacture, lies in the fact that they are not poisoned by such substances as arsenic or hydrochloric acid, which impurities are frequently encountered in commercial sulfur dioxide gases, especially those from metallurgical roasters.

“In the case of a platinum mass, the usual experience is that such poisons result in a gradual but continuous decrease in activity, with consequent increase in the manufacturing cost in sulfuric acid. The advantage of a contact catalyst which is not affected by such poisons, and which constantly gives a high conversion, is obvious; and such has been our experience with these new catalysts over extended periods of time.

“With the exception of this marked advantage, the behavior of these new catalysts with respect to temperature, conversion equilibrium and activity, closely parallels that of the best platinum catalysts. It is believed that within the next decade the use of platinum catalysts for sulfuric acid will be entirely abandoned and the use of vanadium catalysts completely established in their stead.”

Water Preferred

CHEMISTRY is credited with a world-wide trend toward prohibition by no less an authority than Dr. William J. Mayo, one of the justly famous Mayo brothers of Rochester, Minnesota. Speaking before the American Chemical Society recently, Dr. Mayo stated his belief that neither prohibition propaganda nor an appeal to the conscience of man has caused the rapid advance of the temperance movement, but that pure water, made available by the application of chemical, bacteriological and engineering knowledge, has made this possible.

“It is assumed that the drinking of spirituous and fermented liquors is due to an evil inborn longing, to be stamped out only by the exercise of individual self-control. Is this true?” asks Dr. Mayo. “In France and Italy the drinking of billions of gallons of wine saved the people from extinction; they could not have lived had they drunk their polluted water. The Teutonic countries turned to beer to secure a sterile drink; England had ale and wine; and temperance countries, such as Turkey, had tea and coffee. Simultaneously with Vienna’s introduction of a pure water supply from the mountains, her per

capita consumption of spirituous and fermented liquor was reduced spontaneously 40 percent. The introduction of a pure water supply in the various states in our country has been followed by a temperance movement, and finally by prohibition.

"The same influence is now apparent in Europe. In England pure water is to be had in the large cities, and a temperance movement promptly results, but in the villages without potable water no such movement is as yet manifest. The drink habit was one of the many forms of protection resorted to by Nature to save man from filth diseases which cause death, or that which is worse than death, intellectual deterioration. Prohibition outlawry is largely from the alien who comes from countries where water could not be used for drinking purposes and also, of course, from the dregs and froth of our own citizens."

Corrosion From the Hands

MANUFACTURERS of highly polished steel products such as mathematical instruments, piston rings, et cetera, have for years been annoyed with epidemics of corrosion without any apparent explainable cause. Every possible precaution has been taken to see that the metal was properly "slushed" with the best rust preventive, so that corrosion from atmospheric moisture or other external causes was seemingly impractical, and the parts were so treated as to obviate practically all probability of corrosion from causes "within," meaning the sweating of the metal beneath the rust preventive film, and yet corrosion would occur, not generally, but occasionally and somewhat mysteriously.

The following key to this puzzling problem and a method of solution is reported in *Black and White*, the organ of Houghton and Company, of Philadelphia.

"Quite a number of years back this problem was put up to the Houghton Research Staff by a prominent cutlery manufacturer and the solution of the problem was effected by the process of segregation and elimination. That is to say, every detail of each piece was tabulated, including the operatives handling each. It was discovered that this corrosion occurred more upon pieces handled by some than by others, and immediately it was concluded that some operatives were more careless than others. But a most careful surveillance of the conditions failed to detect such carelessness.

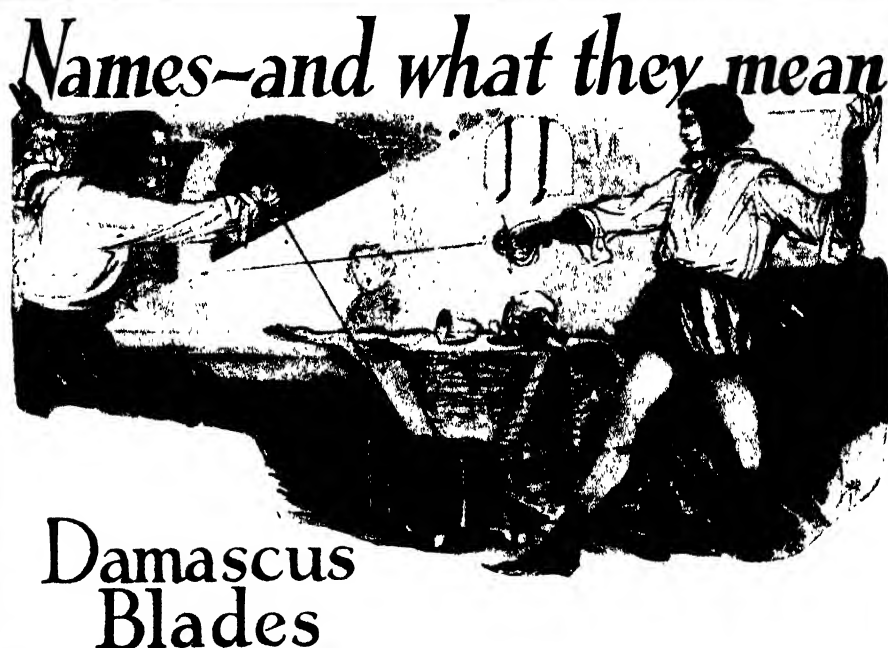
"Then the thought occurred that perhaps the corrosion was due to the corrosive influences of the acids from the perspiration. Accordingly the perspiration coming from those operatives whose work showed the least corrosion was examined and compared with those that caused the most and invariably the analyses showed excessive acid content in the latter.

"A prominent manufacturer of high-grade piston rings went through practically the same experience as the cutlery manufacturer and effected a remedy in the following and very unique manner. After ascertaining that the neutralizing of the acids on the operatives' hands with alkaline solution was not practical owing to the injury to the skin, they reasoned thus:

"If the rust preventive which we use to prevent corrosion after the rings are finished contains an inhibitor which neutralizes corrosive influences from within, why would it not be practical to apply that rust preven-

(Please turn to page 181)

Names-and what they mean



Damascus Blades

In those days a man's life was very often worth no more than the quality of steel in his sword. Out of the Orient came a steel that was called Damask. Blades made of it proved themselves in the hands of the greatest swordsmen to be of wonderful strength, keenness and temper.

In time these splendid swords became known as Damascus blades and the name came to stand for superlative qualities, qualities that meant so much to a man when all that stood between him and sudden extinction was a strip of steel half an inch wide.

So great was the excellence of these swords that to this day the best Damascus blades remain some of the greatest examples of the swordmakers' craft.

In different fields and times the name

Tycos

has earned the title "Industry's Sixth Sense."

TYCOS is the symbol of an extensive line of temperature instruments that go far beyond the greatest possibilities of the five senses. In the industrial fields they enable manufacturers in a thousand varied industries to know, to record and to control temperatures. They do this in uncounted processes where such knowledge, control and records are absolutely essential to success.

Manufacturers having to use correct temperatures in their undertakings will find TYCOS engineers always ready and willing to help solve problems of this nature, usual or unusual. They will find TYCOS instruments accurate, reliable and capable, worthily earning their present reputation as INDUSTRY'S SIXTH SENSE.

Names usually begin by being merely a label or tag by which to identify things. Some names acquire through the years and as a result of outstanding merit in the product itself, a deeper significance. Such names become a sort of measure for excellence, a standard by which to judge similar products or things.

Many years ago the name TYCOS was chosen as the symbol of a line of temperature instruments. Beginning with the ideal of making the most complete as well as the most reliable and accurate temperature instruments possible, the makers by strict adherence to this ideal through years of experimentation and research have produced a remarkable line of instruments. Successfully meeting all kinds of temperature problems has resulted in TYCOS becoming known everywhere as the mark of excellence in temperature instruments.

There are TYCOS instruments for all needs. Besides the great variety of industrial instruments there are household and medical instruments. For the home there are outdoor and indoor thermometers, oven, bath and candy thermometers. For the foretelling of weather there is the Stormoguide.

There are fever thermometers and sphygmomanometers. In fact, in the following list we can only give a suggestion of the many instruments bearing the name TYCOS and their uses.

All these instruments can be bought at your dealers or we shall be glad to send them direct if he does not carry them. Write for literature on the type of instrument that interests you.

Tycos

Temperature Instruments
INDICATING - RECORDING - CONTROLLING

Office Thermometers

An aid in promoting human efficiency.

Bath Thermometers

To enable you to get the most good from your bath.

Home Sets

Bake Oven Thermometer, Candy Thermometer, Sugar Meter. The secret of accurate results in cooking.

Wall Thermometers

To help you maintain a temperature in your house conducive to good health.

Quality Compasses

To show you the right way in unfamiliar country.

Fever Thermometers

A necessity in every home.

Stormoguides

Forecast the weather twenty-four hours ahead with dependable accuracy.

Hygrometers

To enable you to keep the humidity of the atmosphere in your home correct at all times.

FOR THE MEDICAL PROFESSION

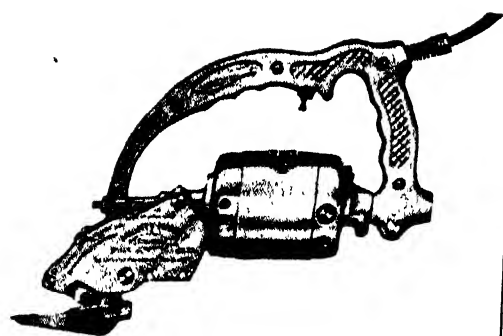
Sphygmomanometers, Pocket, Office and Recording types. Urinalysis Glassware. Fever Thermometers.

Taylor Instrument Companies

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Why We Chose the Dumore Motor

"We have been frequently asked why we use Dumore Motors in our Mighty Midget Unishear. We use them because—

We have long been familiar with the satisfactory performance of Dumore Motors.

In developing our Mighty Midget Unishear we found a highly satisfactory cooperation on the part of the Wisconsin Electric Company in furnishing us with a motor suitable for our requirements.

Out of over two thousand Dumore Motors now in heavy service on our Mighty Midget Unishears, we have experienced practically no difficulties and wherever we did have trouble it could always be traced to neglect on the part of the user."

THE UNISHEAR COMPANY, Inc.
G. A. Unger, Consulting Engineer

THE Mighty Midget Unishear has taken an important place in metal cutting work, filling a long felt need for a portable, power driven machine that combines accuracy, speed and easy operating features.

Manufacturers of motor driven appliances will find several outstanding advantages in Dumore motors. Every motor is dynamically balanced—a process carried out on a special machine of our own design. Vibration caused by unbalanced weight is eliminated. The bearings are protected, the dynamically balanced motor runs without noise, it uses less current and operates efficiently much longer than a motor not in dynamic balance.

This special feature of Dumore motors is backed by proven construction methods, special insulation, extreme accuracy of all parts and close inspection of every operation. The resulting superior quality has been placed on a production basis, giving you the advantages of outstanding performance at no increase in price.

Let our engineering department explain the advantages of dynamic balance in the motor, applied to your machines. Write.

DUMORE

TRADE MARK—REG. U. S. PAT. OFF.

**Dynamically Balanced
Universal Motor**

WISCONSIN ELECTRIC CO.,
46 Sixteenth St., Racine, Wis.

The Back Yard Astronomer

(Continued from page 172)

scope mirror (stellite) which is now on exhibition in the American Museum of Natural History, New York.

"The organization is called 'The "Y" Telescope Club' and meets at 7:30, every Thursday evening, in Room 121, 1421 Arch Street. It is open to young men of high school age and over.

A list of those in Philadelphia who have evinced an interest in amateur work of this kind by purchasing copies of "Amateur Telescope Making" is being sent the club.

Finally, may we recite a joke, taken from

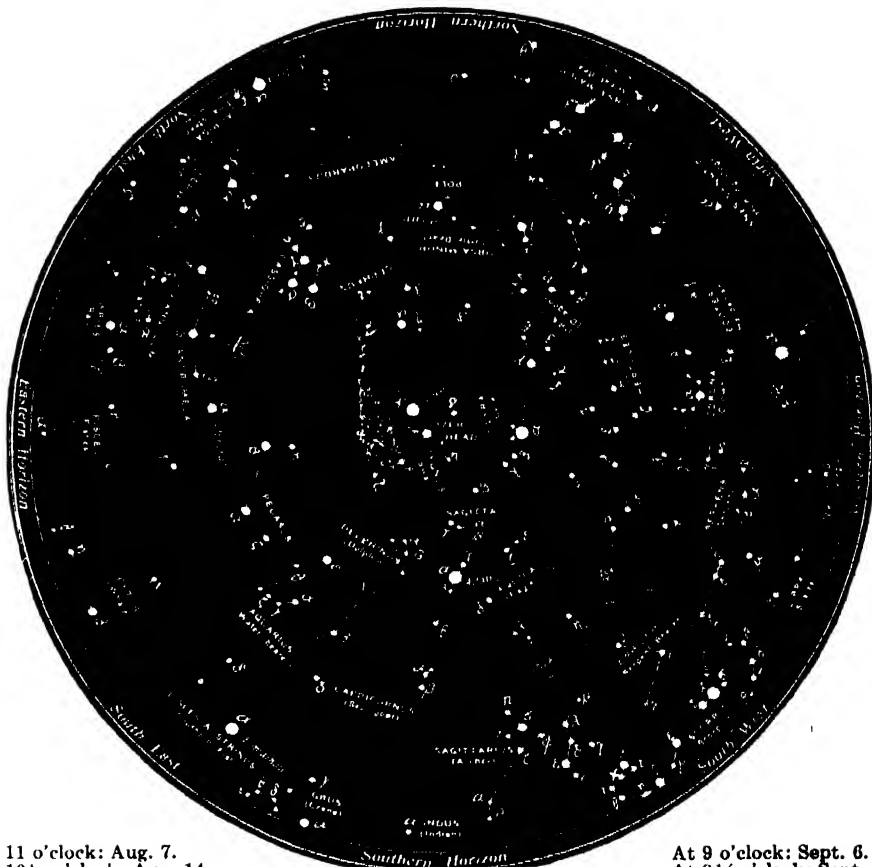
the *Wright Engine Builder*, a house organ? It seems that two darkies who were discussing the relative merits of the sun and the moon said:

"De sun am de bes'; dey cain't be no doubt about dat," said Sam. "Look at how much mo' light she give dan de moon. You ain't tryin' to convince me dat de daylight ain't brighter dan de moonlight, is you?"

"Dat's all right about de sun givin' de mos' light," replied Joe, "but you is got to remember dat de moon deserves de mos' credit because de light she gives come at night when it would oderwise be dark, while de sun shine in the day time when it am light anyhow."

The Heavens in August

By PROF. HENRY NORRIS RUSSELL, Ph.D.



At 11 o'clock: Aug. 7.

At 10½ o'clock: Aug. 14.

At 10 o'clock: Aug. 22.

At 9½ o'clock: Aug. 29.

At 9 o'clock: Sept. 6.

At 8½ o'clock: Sept. 14.

At 8 o'clock: Sept. 21.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on August 7, etc.

NIGHT SKY: AUGUST AND SEPTEMBER

MERCURY is an evening star until the 16th when he comes between us and the Sun, although not exactly in line, and begins to figure as a morning star. He can be seen only at the beginning and end of the month, if at all.

Venus is now an evening star but is still pretty near the Sun, and even at the end of the month she sets only a few minutes after seven o'clock.

Mars is in Taurus, approaching quadrature, and is steadily coming nearer and growing brighter. By the middle of the month he rises at 11 P.M.

Jupiter is in Aries and rises nearly two hours earlier than Mars. Last month the two were close together, but Mars has moved eastward while Jupiter has stood nearly still in the sky.

Saturn is in Scorpio and is due

south in the early evening about 7 P.M.

Uranus transits about 2 A.M. and is observable in the morning.

Neptune is in conjunction with the Sun on the 22nd and is unobservable.

The Moon is full at 10:30 A.M. on the 1st; in her last quarter at 12:24 P.M. on the 8th; new at 8:49 A.M. on the 15th; in her last quarter at 3 A.M. on the 23rd; and full again at 9:34 P.M. on the 30th (all these times as usual are Eastern Standard, not daylight saving time). She is nearest the Earth on the 10th and farthest off on the 23rd, and as she swings around the sky she passes Uranus on the 5th, Jupiter on the 8th, Mars on the 9th, Mercury on the 15th and Neptune a few hours later the same day, Venus on the 16th and Saturn on the 24th. The conjunction with Mars is close and an occultation is visible in Asia.

The Scientific American Digest

(Continued from page 159)

over three sixteenths of an inch high, and is seven thirty-seconds of an inch long from one end of the shaft to the other. The frame and the armature are of iron, and the base, under which the wires are run in grooves, is of solid brass. It has two field poles, each coil of which is wound with 35 turns of number 36 varnished copper wire; and four armature poles, each coil of which is wound with 20 turns of number 40 varnished copper wire.

The armature is slightly under one eighth of an inch in diameter, and the commutator is approximately half of that. The commutator has four segments, and the brushes, which are adjustable, are of gold. The shaft is less than one sixty-fourth of an inch in diameter. Tiny watch screws were used to hold together the parts, of which Mr. Gomez says there are a total of 48 in the motor. A small flashlight cell supplies the power to run it.

Not content with making the motor, Mr. Gomez proceeded to make an elevator mechanism to be run worm-screw fashion by it. This mechanism is one and one eighth inches high. It has a steel drum five sixteenths of an inch in diameter and three sixteenths of an inch wide with side flanges one sixteenth of an inch high.

Mr. Gomez did not tell us how soon he expects to take his trip to Spain.

Lindbergh Beacon Turned On

THE Lindbergh Beacon, an 8,000,000-candlepower airport light, built by the General Electric Company and erected atop the City Hall tower in Los Angeles, was



The Lindbergh beacon, Los Angeles

officially turned on recently by President Coolidge by the touch of a button in the White House at Washington. The light is in the nature of a monument to Colonel Lindbergh, presented to him by the people of Los Angeles.

The beacon is lighted by a 900-watt filament lamp, burning before a 24-inch mirror, the beams pouring through a 24-inch lens. The reflecting mirror is so designed as to throw a concentrated beam of light that can be seen a distance of 60 miles in fair weather. The beacon will revolve six times in a minute.

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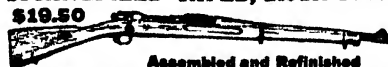
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the tremendous concentrating power of the reflecting mirror was noted when the workmen were installing and adjusting the beacon on the tower. The sunlight, caught by the mirror and reflected, fell upon the workmen and burned the hair off their arms in an instant. They were forced to turn the mirror to the north, away from the sun.

Another interesting feature of the beacon is that there are two lamps in it. They both rest on the same base, which is pivoted, the working lamp being at the focal point. Should this lamp burn out during the night the base carrying the two lamps will trip the new lamp into focus automatically and light it. This feature is necessary particularly where the beacons, which are standard government lights used on the national airways, are placed in out-of-the-way places and are visited only once a month by caretakers. On such lights, when the first lamp burns out and the new one swings into place, there is a red light on top of the beacon which also is lighted, informing the passing aviator that the first lamp is burned out and that the emergency lamp is burning.

German Process Separates Oil

A PROCESS for getting oil out of steam condensation water has been developed by Fritz Hoyer, a German scientist. It is expected to replace the mechanical methods for removing the troublesome residue of oil now in use.

Most of the oil which is used for lubricating steam pistons and gearing is atomized and carried away in the waste steam. As a result of this, a very stable milky emulsion is formed on the condensed water, and the problem of separation of oil and water is an extremely difficult one. Many mechanical oil separators have been tried, but up to the present they have not been an unqualified success, and when the condensed water which has passed through them is used for the boiler, appreciable quantities of oil also pass in. This oil combines with the boiler scale to form a solid mass which settles on the walls of the boilers and tends to cause overheating of the plates.

In the Hoyer process a direct current is passed through the water, which collects the oil in small foam flakes, thus destroying the emulsion and making filtration possible. The consumption of electricity is about one kilowatt hour for five cubic meters of water.—*Science Service.*

New Device Locates Source of Machinery Knocks

THE usual method of detecting and locating blade rubbing in steam turbines, loose pistons, cross-head and main-bearing knocks in steam engines, and similar troubles in power-plant machinery, is by means of a pencil, rod or other device placed with one end on the machine and the other end in the ear or between the teeth. With a view to simplifying this part of the engineer's duties and making it possible for him to locate more readily and accurately the exact position of the knock, the improved twin model Transmit-O-Phone illustrated was recently introduced by the International Metal and Specialty Company, Berlin, New Jersey.

The instrument consists essentially of the headpiece, and twin amplifiers, with connecting hose, vibration disks, and sound-

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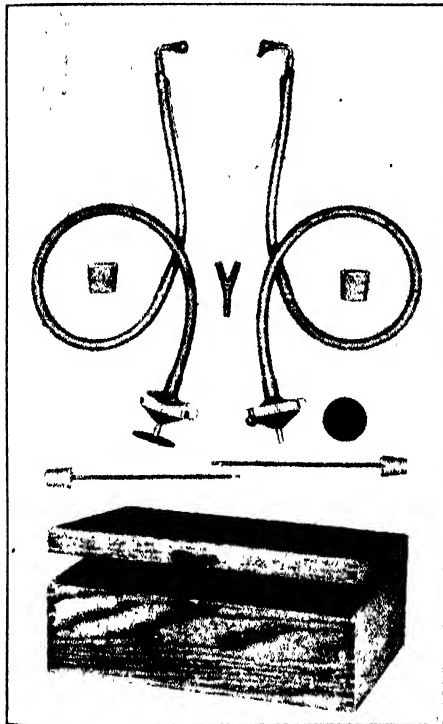
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transmitting rods, together with corks to clarify and cushion the sounds.

The advantage of the two amplifiers over one, as generally used on instruments of this kind, is that the location of the knock is more readily determined, and it permits the operator to distinguish two different sounds in close proximity to each other or to detect sounds from two different points at the same time.

The ear tabs are offset to fit snugly and evenly in each ear, and to keep out external sounds. The disks are used for locating light sounds, and the rods with the



The stethoscope-like instrument for locating machinery knocks, explained in the accompanying article

cork tips for sharp or loud sounds, the corks having a cushioning and clarifying effect. The Y-piece is used where one amplifier only is necessary to locate the sound.

Among the uses claimed for the instrument, in addition to those already mentioned, are: detecting leaky steam valves, loose journals, leaky steam traps, leaks in air and water lines, and locating hidden pipes and conduits. It might be used, for example, to locate a ferrule on a street water main, or a paved-over curb box. A man "listening in" on the pipe where it enters the building will hear a distinct, sharp note when a helper outside taps the pavement over the point sought.

The instrument and attachments come packed in a hardwood case.—*Power.*

Many New Uses for Bakelite in the Home

IN the era of building construction through which this country is now passing, great impetus has been given to creation and development of superior building materials, equipment, tools, and supplies. Efforts have been directed toward expediting construction activities through labor-saving devices. Demand for the best facilities has brought manufacturers in competition to supply the most improved hardware, fixtures, and finishings. Architects and builders have readily adopted these im-

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Science and engineering have co-operated to produce new building materials and devices which have brought revolutionary changes, not only in design, but in dependence upon sources of supply. The science of chemistry has been called upon and has responded with the development of materials from agricultural wastes such as straw, corn stalks and sawdust. The result in many instances has been the development of more durable materials, capable of withstanding heat and the ravages of the elements.

Among building materials which have come into general use during the past year, derived from chemical synthesis, are the bakelite resinoids. These materials are



Some of the many applications to which bakelite may be put. These articles were molded in bakelite

capable of fabrication into many unique forms which make them useful in a wide range of building operations. They are created in the laboratory from chemicals derived from coal and wood—phenol, cresol, and formaldehyde.

Bakelite materials have been adopted extensively in the improvement of tools. The blow-torch, the electric drill, and the paint sprayer utilize them because of their properties of heat and electrical insulation, and resistance to corrosion. They provide molded switch plates and other electrical fixtures, escutcheon plates, door knobs and other hardware. In the electrical field, of course, the phenol resinoid materials have early been recognized for their dielectric strength. Added to this, however, are the properties of mechanical strength, high luster, and the range of color effects in the finished product.

In every room of the modern home these materials may be found in some form—dials in the radio set, the telephone mouth-piece, the cement in electric lamps, outlet plugs, et cetera. The red wheel of the Lorraine stove and the agitator of the Meadows washing machine are other examples. Tables are now made with Bakelite tops undistinguishable from marble, mahogany, or oak.

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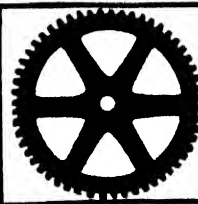
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(Continued from page 175)

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Will Aminoplastics Replace Glass?

THE advent of Polloplas or "synthetic glass" in Europe a few years ago has produced continued interest in clear resinoid condensation products which may be



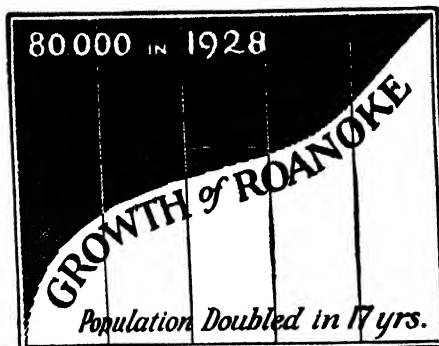
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the course of the reaction depending on the one hand on the proportion of the acrolein to urea, and on the other hand on the presence or absence of catalysts, solvents or diluents and also on the temperature of the reaction."

Rubber-Coated Steel Finds Useful Applications

AN interesting development in chemical engineering which should find useful application in numerous other fields, is a special rubber lining for vessels used for hydrochloric acid. The lining takes the form of a plastic rubber compound, which can be applied to the surfaces of tanks and vessels. It toughens or vulcanizes at 90 degrees, Centigrade. The lining is obtained in sheets of varying thickness. The surfaces of the iron vessels are first cleaned and sweated free from moisture, covered with a special solution and allowed to dry. On this is laid the rubber sheet, carefully rolled to remove all air from between the sheet and the metal. The jointing of two adjacent sheets is done by first rolling down the edge of one sheet, smearing this surface with naphtha, then laying on that the edge of the next sheet and pressing down with a tool heated to 35-40 degrees, Centigrade. When heated to this temperature the rubber lining becomes soft and dough-like.

What Will Happen to the Tin Can

NO doubt every small boy shares the double illusion concerning tin cans; first, that they are made of tin; and second, that empty cans on rubbish piles are devoured by ravenous billy-goats. While most of us lack evidence either to substantiate or disprove the latter tradition, we learned long since that the tin can is really made of sheet iron plated with tin to render it rust proof, inert to the food it contains, easily workable and conveniently receptive to solder.

Data issued recently by the Tin Statistical Research Bureau of London indicate that the world is facing a tin famine. The Bureau points out that the United States, being the greatest consumer of tin, will be the first to feel the effects of the growing shortage of this metal. Since 1919 the world's available stocks of tin have dropped from 18,000 tons in that year to about 4500 tons at the present time. In the last 30 years the price of tin has risen some 500 percent.

It would take a long list to mention the articles into which tin enters as an important material. But there is no doubt but that one of the principal, if not the most important use, is for tin cans. Possibly the growing scarcity of tin will eventually turn the canners to lacquered or perhaps chromium-plated cans. Possibly, sheet iron will be replaced entirely by some other material. J. Newell Stephenson, editor of *Pulp and Paper Magazine* of Canada, sees the possibility of paper or cellulose "cans."

"Cellulose, which is available in unlimited quantities, is not by any means the equivalent of any metal in all its properties," he admits. "We are convinced, however, that research can eventually develop, through parallel work on the preparation of the material used for the container and the treatment of the article to be contained, such co-ordinated processes that cellulose products can be used very largely as successors—we prefer that word in this

instance rather than substitutes—to the metal container now almost universally used. We have no doubt that cellulose will be found to possess properties not more than suspected at the present time, and which will be found to be adaptable to the production of a great variety of products whose value will be more obvious as time goes on."

Paper From Grape Vines

SHADES of Bacchus! That erstwhile popular god must certainly storm the gilded streets of Olympus as he sees the uses to which the native sons of California turn the grape. Grape juice (containing benzoate of soda) must have caused a pang of sorrow; the pretty little red boxes that have induced us to "eat more iron"—as raisins—must have given him wistful pause; but the crowning indignity is now contained in the news that a California company has been formed to manufacture paper made from grape-vine cuttings.

Chemically, and from the paper maker's point of view, this is an interesting project. The new plant, known as the Sacramento Pulp and Paper Company, is to be located in Sacramento and is capitalized at a million dollars. Plans for the initial unit of the plant call for the manufacture of 25 tons of wrapping paper per day, which would give employment to about 80 persons, with a daily payroll of about 500 dollars.

Mr. H. D. Wagon, one of the directors, is the discoverer of the process for making pulp and paper out of grape vines and has protected it by applying for a patent covering the gathering, treating and manufacturing process.

It was decided to establish the factory in Sacramento because this city is the center of the grape industry of the state. Within a radius of 50 miles are planted about 100,000 acres of grape vines, thus affording for the proposed pulp and paper mill a large supply of raw material.

The use of grape vines is an innovation in the pulp and paper industry. Through utilization of this medium it is confidently expected by the backers of the project that production cost in raw material will be materially decreased.

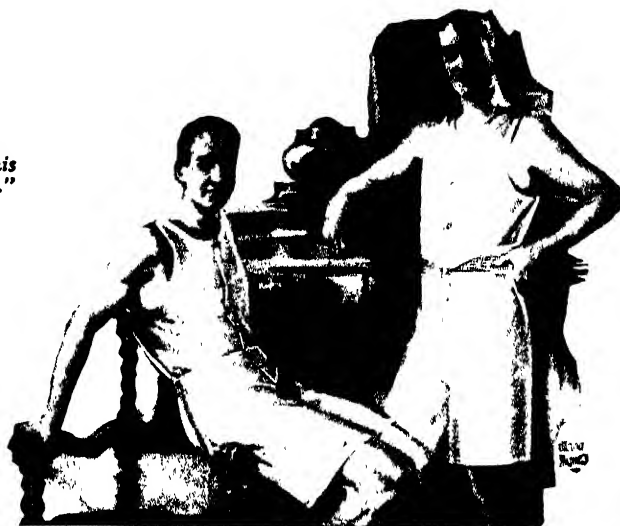
Tires—Rubber or Zinc?

FEW realize that the ordinary high-class automobile tire contains many other things besides rubber. Zinc oxide, for instance, is used in greater tonnage than any other compounding ingredient for rubber, not alone because it is an excellent white pigment, but also because it reinforces rubber compounds with relatively little sacrifice to their resiliency. The rubber used in tires must, of course, be reinforced in some way, for pure rubber, while resilient, will not stand wear and tear of the road.

The rubber tread of the average size solid tire weighing about 100 pounds is composed of 34 pounds of first quality rubber, one and one half pounds of sulfur, four and one half pounds carbon black, and 59 pounds of zinc oxide. Zinc oxide also fills an important place in the modern giant pneumatic bus tires and in the regular passenger "balloon" tires. While our tires are generally spoken of as rubber tires they are in fact composed only of about 50 percent rubber. The remainder of the tire is composed of materials to cure the rubber, increase its wear, and protect it from injury.



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By George B. Cressey

EVERYONE who enters Chicago from the east passes through the curious area of immense sand dunes at the south of Lake Michigan. Others of us have noticed and wondered at the curious dune formation in many other places. A geologist, long familiar with desert dunes in Mongolia, has worked out the underlying science of the Indiana dunes—their shapes, arrangement and peculiar shiftings—and found a surprising amount of order in it. Those who visit the seashore will find many hitherto puzzling phenomena made clear by this interesting study. Illustrations and map. . . . \$2.15 Postpaid

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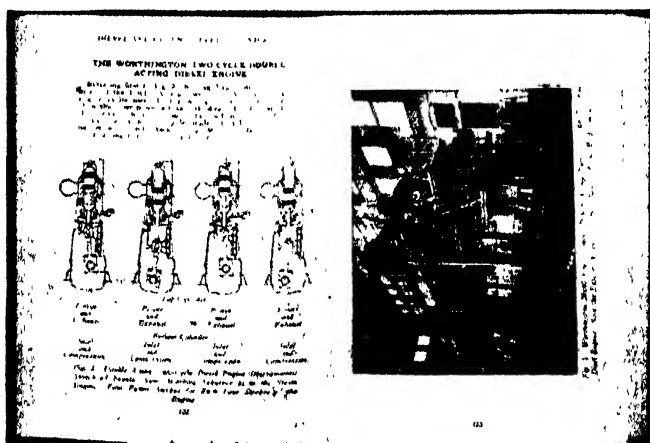
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Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Safety Pins

A FRIEND of ours was sitting in the office the other day talking about inventions.

"By the way," he said, "did you know that it was my great-grandfather who invented the safety-pin?"

"No," we replied, "tell us about it."

"He had a machine shop. One day, a friend of his came in wearing a cape. It was a cold winter day; the cape was blowing open and the newcomer asked to borrow a pin. My great-grandfather gave it to him. He fastened the garment together with it in a rather clumsy fashion.

"Let me show you how to do that," said my great-grandfather. He took the long pin, bent one end over to form a sort of holder; then he bent the pin into a circle in the middle to form a sort of spring and gave it back to the man.

"There," he said, "try that. You will find that it will hold your cape more securely; it won't come out and there is no danger of your pricking your finger on the point."

"That is a fine idea," said the visitor, "you ought to get a patent on it. I bet there will be a lot of money in it."

"Oh, there is nothing to that," said my great-grandfather. "It is just one of those things that anybody can do." The visitor, however, was impressed with the idea and he himself took out a patent, claiming to be the inventor, and made a considerable amount of money out of it."

"What was the name of this great-grandfather of yours?" we asked our friend.

"Walter Hunt."

"Well now, we don't like to upset any family traditions, but it happens that your great-grandfather did take out the original patent for the safety-pin. Whether he made any money out of it or not, we don't

New York City, for a "Dress-Pin." While dress-pins and clasps of one kind and another have been known since the dawn of history, this, so far as either of us knew, was the first safety-pin patent issued in this country.

"The distinguishing features of this invention," the patent read, "consist in the construction of a pin made of one piece of wire or metal combining a spring and clasp or catch, in which catch the point of said pin is forced and by its own spring securely retained. They may be made of common wire, or of the precious metals.

"Any ornamental design may be attached to the bar, which combined with the advantages of the spring and catch, renders it equally ornamental, and at the same time more secure and durable than any other plan of a clasp pin, heretofore in use, there being no joint to break or pivot to wear or get loose as in other plans.

"Another great advantage unknown in other plans is found in the perfect convenience of inserting these into the dress, without danger of bending the pin, or wounding the fingers, which renders them equally adapted to either ornamental, common dress, or nursery uses. The same principle is applicable to hair-pins."

The safety-pin as Walter Hunt conceived it is, in principle, much the same as we know the safety-pin today. There was probably no substantial change or improvement in it for 28 years. In 1877, by which time the term safety-pin had come into use, William A. Butler, also of New York City, obtained a patent.

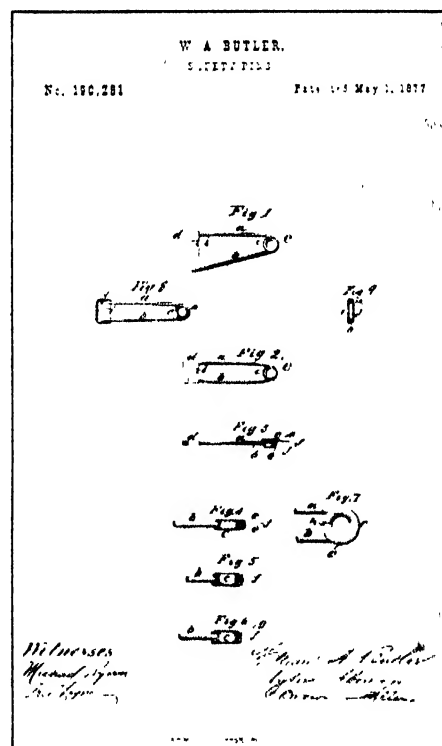
He provided a re-enforcing ring placed between the bifurcations, explaining his improvement as follows:

"A serious defect in safety-pins avoided by my invention is the liability of injury to fabrics and tissues, caused by a portion of the same working in between the coils of the spring which connects the bifurcations of the pin. In adjusting such pins in portions of the dress, the turning of the pin longitudinally, after the pointed bifurcation is inserted in the fabric, frequently forces a portion (perhaps consisting of a few threads only) in between the coils of the spring, which hold such engaged portion of the fabric so forcibly that it is only by great care disengagement can be effected without breaking out the portion so engaged, which breaking and injury often result in spite of all efforts to prevent it.

"I obviate this action and defect by my re-enforcing ring, which not only strengthens the pin, but prevents any portion of the fabric from engaging with the coils of the bent part when the same is coiled, and which also enables me to obtain sufficient resilience in the spring without coiling the bent portion of the same for a spring between the bifurcations of the pin."

Walter Hunt, the original patentee of the safety-pin, has a place in the history of invention for something entirely different. He is recognized by those familiar with the subject, as the original inventor of the sewing machine.

Between 1832 and 1834 he built and sold workable sewing machines—all of his own design. His machine was of a locking stitch variety, that is, it made a stitch consisting of two



Butler's improvement had a guard to prevent catching the clothing

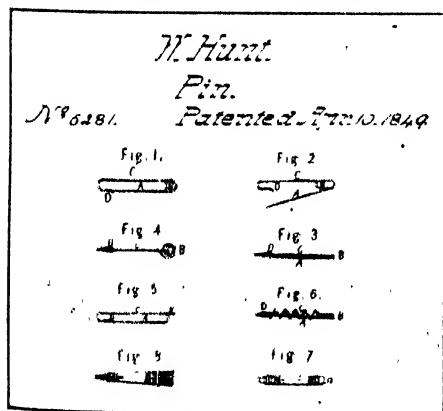
threads twisted together in such a way that they could not be raveled out as easily as could the simple stitches of earlier machines.

He also invented the eye-pointed needle which led to the machines of the present day. He never applied for a patent, however, on his sewing machine inventions until years later. By that time, Elias Howe, whose work was undoubtedly done later than Hunt's, had applied for a patent, and Hunt was too late in taking the necessary steps to obtain the fame and fortune which might have been his rather than Howe's.

Exporters Beware

AMERICAN firms likely to do business in foreign countries are warned against the practices of trademark pirates, by the Commercial Laws Division of the Department of Commerce. Recommendation is made that the Americans protect their rights by prompt registration of the marks.

It is said many instances of piracy have arisen lately. One concerns a certain South American who visited the United States in 1927, calling upon manufacturers of well-known radio apparatus. This year, in his own country, he has registered their trademarks—about 40 in number—in his own name. Protest has been made to the



The patent for Walter Hunt's pin, made from a single piece of wire

know; but it just happens that we have a copy of Walter Hunt's safety-pin patent in our desk."

We dug down into the bottom drawer and brought out, much to the surprise of our friend, patent Number 6281, dated April 10, 1849, issued to Walter Hunt, of

applications for registration, but probably too late, and the pirate is now in a position to sell his rights to competitors of the American manufacturers and may even confiscate the American goods should they arrive at a port in his country, bearing a trademark of which he is the registrant.

It is admitted that registration of a trademark is impracticable in every country in which goods may at some time be sold, because of the expense involved. In some countries registration is granted to the first applicant for registration. In other countries—and in these the situation is most dangerous—registration is granted to the first applicant, regardless of use. A definite period of time, however, is usually allowed for protesting the application for registration.

In a warning recently issued against trademark pirates, James L. Brown, chief of the Patents and Trademarks Section of the Division, says:

"When a so-called piracy has been committed, the usual course left open to the person believing himself injured as a result thereof is to take action in the civil courts against the infringer, although, in some instances, criminal action may be maintained owing to penal provisions in the laws. American firms, therefore, must be vigilant—not only in protecting their trademarks, trade names, and labels in those countries in which they are now doing business, but also in countries apparently offering potential markets."

The Bureau of Foreign and Domestic Commerce through its foreign offices is assisting American firms to make contacts with foreign business concerns, but it cannot assume the position of an arbiter when the rights of an American firm have been jeopardized through its own negligence. The exporter should rely upon his own vigilance and prompt action.

The Wicker Furniture Case

THE Federal District Court for New Jersey has recently upheld the patent in which Marshall B. Lloyd in 1917 disclosed the invention which revolutionized the manufacture of wicker furniture. Suit was brought by L. H. Greenwood, O. W. Siebert, and W. E. Holman, trustees, against the Monarch Manufacturing Company and the Gardner Fiber Company.

"In the prior art, reed furniture, such as chairs and baby carriages, was hand woven, just as the Aztec Indian made his baskets," Judge Bodine says. "By the Lloyd method, the fabric is separately woven, and applied to the frame. There is a saving of nine hours of skilled reed worker's time in the manufacture of an ordinary wicker chair. In the old weaving art, months were consumed in teaching the worker. The worker can now be trained to apply the fabric in two weeks. The saving is enormous. At least half of the wicker furniture upon the market is now made by the Lloyd process and 99 percent of the Heywood-Wakefield baby carriages are so made.

"The gist of the novelty in Lloyd's invention is in reshaping the material upon the frame to be covered so that neither cutting, nor piecing, nor folding the fabric is necessary. Lloyd saved the industry the tedious hand process of making stake and strand furniture by the hand weaving process. He saw how the fabric could be shaped to produce the same results as

were produced by the old and expensive method.

"The defendant, Gardner Fiber Company, manufactures stake and strand fabric suitable for the manufacture of wicker furniture under the Lloyd method, and the defendant, Monarch Manufacturing Company, buys the fabric to use in the manufacture of wicker furniture. Obviously, the Gardner Company knew what the Monarch Company was going to do and persuaded them to undertake the use of their goods. Both defendants are infringing the patent, one by weaving the fabric, and the other by reshaping the fabric and attaching it to the chair frames.

"In administering the patent law the court first looks into the art to find what the real merit of the alleged discovery or invention is and whether it has advanced the art substantially. If it has done so, then the court is liberal in its construction of the patent to secure to the inventor the reward he deserves. If what he has done works only a slight step forward and that which he says is a discovery is on the border line between mere mechanical change and real invention, then his patent, if sustained, will be given a narrow scope and infringement will be found only in approximate copies of the new device."

Patent Appeals Transferred

THE United States Court of Customs Appeals has been changed to the United States Court of Customs and Patents Ap-

peals President Coolidge having signed the bill providing for the change. Heretofore appeals in patent cases have been taken from the Patent Office to the Court of Appeals of the District of Columbia or, in some cases, to some of the numerous United States District Courts throughout the country.

The purpose of the change is explained in a report by the Senate Committee on the Judiciary as follows:

"The need for the legislation is due to the fact that the Court of Appeals of three judges has a very crowded docket and is considerably behind in its work while the United States Court of Customs Appeals, consisting of five judges, has a relatively light docket. The bill has the approval of both courts as well as the Department of Justice."

Patent Brokers in Germany

IT is no uncommon thing for an inventor to find that marketing his patent is a far more difficult task than making the invention. With manufacturers it is no problem to make a product if they know what to make. The problem lies in finding a suitable article to manufacture. These two needs provide the opportunity for the patent broker.

In industry there is a legitimate place for a patent broker. Unfortunately, however, the business is a difficult one and the rewards in it have at times attracted men whose principles are not of the highest.

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Aeronautics

AIRCRAFT AND AIRPLANE CONSTRUCTION—Which is of compact and symmetrical form, of great carrying power, capable of developing a high speed, and also capable of approximate hovering over any desired point. Patent 16688889. W. Chalmers, 1011 Howell Ave., Sacramento, Calif.

Pertaining to Apparel

SHOE-TIE-CLAMPING DEVICE—An ornament for concealing the knot from view on women's tie pumps, and retaining the ribbon bow in tied condition against accidental displacement. Patent 1668415. J. Mascali and P. Roma, c/o Mascali & Benenati Shoe Co., 3901 14th Ave., Brooklyn, N. Y.

METHOD OF MAKING SHOES—Of the McKay type, of simple construction, attractive in appearance, lighter in weight, considerably more flexible and comfortable to wear than the conventional shoe. Patent 1668479. S. Ansaldo, 1745 80th St., Brooklyn, N. Y.

RUBBER HEEL FOR SHOES—A simple device capable of being readily applied to the heels of shoes, and which is easily detachable when worn to permit of substitution. Patent 1668980. G. H. Schmidt, P. O. Box 31, Alhambra, Calif.

Chemical Processes

SOLUBLE-FOOD PRODUCT HAVING FRESH KOLA AS A BASE AND PROCESS FOR PREPARATION OF THE SAME—The product being imme-

diately soluble in aqueous beverages, and chiefly breakfast drinks such as coffee, tea and like infusions, without altering their taste or appearance. Patent 1669326. A. and E. Chalas, c/o C. Bletry, 2 Boulevard de Strasburg, Paris, France.

Designs

DESIGN FOR A COMBINED DESK SET AND PICTURE FRAME—Patent 74980. H. A. Kretschmer, 401 No. Leavitt St., Chicago, Ill.

DESIGN FOR A LADY'S HAND BAG—Patent 74957. M. Arnold, c/o Herman Schenors Son & Co., 33 Crescent St., Long Island City, N. Y.

DESIGN FOR A STICK-CANDY WRAPPER—Patent 74982. C. R. Luce, 215 Suydam Ave., Jersey City, N. J.

DESIGN FOR A POCKET LIGHTER—Patent 74988. W. Raeburn, c/o Bernhardt Co., 127 W. 30th St., New York, N. Y.

DESIGN FOR A CURTAIN-POLE BRACKET OR SIMILAR ARTICLE—Patent 74965. J. O. Crawford, c/o John Kroder & Henry Reubel Co., 107 E. 17th St., New York, N. Y.

DESIGN FOR A CURTAIN TASSEL OR SIMILAR ARTICLE—Patent 74986. J. O. Crawford, c/o John Kroder & Henry Reubel Co., 107 E. 17th St., New York, N. Y.

DESIGN FOR A CURTAIN-POLE END OR SIMILAR ARTICLE—The inventor has been granted four patents for ornamental designs of this nature. Patents 74962, 74963, 74964, 74967. J. O. Crawford, c/o John Kroder & Henry Reubel Co., 107 E. 17th St., New York, N. Y.

There have been many experiences of inventors which justify scrutinizing closely the ways and methods of any man or firm seeking to act as intermediary between the inventor and the manufacturer.

In Germany an interesting experiment is being undertaken. A limited number of patent brokers, who wish to distinguish themselves from others in the business who are not entitled to public confidence, have formed a "Chamber of Industrial Brokers" (*Kammer Deutscher Industrie-Makler*). The object of the institution is to establish and maintain the reputation of the profession of its members. It co-operates closely with the Government Board of Industry and Commerce, with other official institutions and with registered patent attorneys. Members are admitted only after careful examination and may be excluded for any breach of business ethics. All inquiries which may be addressed to the institution are submitted at regular meetings and distributed among the members.

So far the idea seems to work out very well in practice. One firm will have unusual facilities for marketing a patent in a particular country or in a particular industry and it is not uncommon for one broker to refer an inventor to another broker who is better qualified in the particular case. Such co-operation, instead of cut-throat competition, naturally works to the benefit of the inventor. The members are all familiar with the tactics of the other members and are, therefore, in a position to prevent anything which might tend to lower the standing of the profession.

Such an experiment is not new in business, but it is new in connection with the marketing of patents. It might be a good idea to have such an organization established in the United States.

The Safety Razor Cases

As everyone knows, the real profit in the safety razor business lies not in the razors themselves, but in the blades. A manufacturer uses the same trademark for both razors and blades, and he can, of course, prevent another manufacturer from using the trademark. Suppose, however, that another manufacturer makes and sells razor blades which he labels as suitable for use in a trademarked razor. In such a case can the original safety razor man get an injunction?

About this question revolved the recent suit of the American Safety Razor Corporation against the International Safety Razor Corporation and others. In the course of the hearings in the Federal District Courts in both New Jersey and Southern New York some interesting facts about the merchandising of safety razor blades was brought to light.

The American corporation makes and sells the "Gem," "Ever-Ready," and "Star" razors and blades; its annual sales of blades alone aggregating more than a hundred million. When the company was formed in 1919, three of the largest companies in the country were absorbed. The Gem corporation was paid 4,000,000 dollars in cash, 3,600,000 dollars of the sum representing the value of the name "Gem," the equivalent of 4,560,000 dollars was paid to the American company for the trade name "Ever-Ready," and 278,000 dollars was paid for the assets of the Star corporation, all but 28,000 dollars of the total sum representing the estimated

Electrical Devices

VARIABLE GRID LEAK—By means of which the reception of the radio waves may be improved by the changing of the resistance. Patent 1668012. A. E. J. Gardner, 853 Lile Ave., Apt. "E," Chicago, Ill.

ELECTRICAL CONDUIT FITTING—Whereby the use of screw threads is entirely eliminated and spring metal sleeves are substituted, for securing electrical conduits to outlet boxes or the like. Patent 1670259. J. J. Herlbauer, 199-23 Hillside Ave., Hollis, L. I., N. Y.

RADIO DIAL CONSTRUCTION—Which will permit one dial to be used to indicate the relative position of two or more adjustable elements, readily applicable to ordinary panel boards. Patent 1670272. A. J. Neef, 1073 E. 39th St., Brooklyn, N. Y.

Of Interest to Farmers

GRAIN SPREADER—Adapted to spread grain when it is being delivered to the furrow so that the seeds will not be crowded and thus cause inferior plants. Patent 1668391. D. Bailey, 108 E. Logan St., Tecumseh, Mich.

SEED FEEDING AND SPACING ATTACHMENT FOR PLANTERS—An attachment for planters of ordinary construction, which will control the dropping of seeds, particularly cotton seed, at desired intervals, providing economy in seed, and in plant thinning. Patent 1669331. E. W. Fullilove, Box 469, Shreveport, La.

THRASHING MACHINE—A small light readily portable apparatus which will effectively accomplish the complete separation of grain from straw, for all kinds of small grain. Patent 1670273. G. E. Nye, McCook, Neb.

APPARATUS FOR TREATING VEGETATION—Especially adapted for spraying or fumigating crops for the purpose of destroying insects and arresting the progress of disease, particularly effective with boll weevil. Patent 1669435. W. W. Wheeler, General Delivery, Shellyville, Ky.

Of General Interest

SPINE SUPPORT—Which may be loosely placed or suspended on a chair of conventional design, and adjusted to fit different sized persons, at the small of the back. Patent 1667626. M. Epstein, 207 Clinton St., New York, N. Y.

COMBINED TENT AND SWING FRAME—Comprising a frame of tubular sections which may be firmly secured for supporting the cover of a sleeping tent, and one or more swinging cots. Patent 1666961. H. E. Delvin, 1412 Ashland Ave., Evanston, Ill.

WALL CONSTRUCTION—Which will provide air circulation, and insulate against heat, cold and dampness, which will conceal bonding material, and insure a proper alignment of the blocks. Patent 1667160. E. H. Kleinfeldt, 1 East 213th St., New York, N. Y.

RUG OR CARPET BEATER—Which may be operated without laborious effort, without the application of electrical or mechanical power, and without injuring or wearing the rug or carpet. Patent 1667605. D. P. Ransom, Woodstock, Vt.

MOP—Which may be cleaned in a bucket of water and wrung for the purpose of drying without the operator touching the wiping element. Patent 1666871. A. De Rose, 37 No. Monterey St., Gilroy, Calif.

TOWEL RACK—Capable of holding a multiplicity of ordinary towels in such manner that individual and successive use is permitted yet securely locked against theft. Patent 1666063. A. W. Aubrey, 427 East 23rd St., Los Angeles, Calif.

BOOK REST—Which can be folded to relatively small size, or extended for supporting books, magazines or articles of various sizes in open position, permitting easy "turning." Patent 1667171. F. D. Sholin, 823 Norwood Ave., Toledo, Ohio.

good will value of the trade name "Star."

In the next six years more than 4,000,000 dollars was spent in advertising to popularize the three brand names. In all forms of advertising, about 8,000,000 dollars has been spent, but in rare instances only has there been mention that the American Safety Razor Corporation is the manufacturer and seller. The public, therefore, does not know that the "Gem," "Star," and "Ever-Ready" are all made and sold by the same manufacturer. The blades have all been standardized as to size and any one of the three blades could be used with any one of the three razors.

Along came the International Corporation, making razor blades and frames under the trade names "Sha-ve-zee," "Liberty," "Mirak," and "Bryford." Blades bearing these names are sold in the ten-cent stores and elsewhere, the package stating that they may be used with "Gem," "Star," or "Ever-Ready," razors. The American Corporation contended that the purchasing public was being deceived into believing that the cartons contained the American's blades.

In the New York Southern District Court Judge Hand issued an injunction against F. W. Woolworth Company, restraining it from selling International's products featuring especially the American's trade names; he permitted, however, a limited use of the American's names in a form which he specified. The wording he approved of was as follows: "Will fit Sha-ve-zee, Gem, Liberty and other razors." The American corporation protested that the relief was insufficient and brought action in the Federal District Court in New Jersey. In denying an injunction, Judge Runyon said:

"It would appear to me that any mental process which could arrive at an erroneous conclusion as to identity of product after inspecting this carton or placard, is either woefully slipshod in its workings, or merits the charge of inherent incompetence.

"As may well be imagined, the complainant has put out an immense volume of advertising, more especially in the exploitation of its Gem and Ever-Ready razor blades. The advertising bears every earmark of intense business rivalry and one could never guess from perusal of these public announcements that the competition between them was any less keen than their own boasted razor edges, concerning the virtues of which the field of fitting superlatives has been drawn upon almost to the point of extinction.

"To me it appears perfectly clear that if the public knew the truth, it would buy that blade of complainant which is sold at the smallest price, and that its ignorance is costing it money without warrant every time it buys a blade at any figure beyond the minimum. Complainant's counsel talks about greater exploitation expenses and urges that fact as one reason for a larger selling price. Why should the vendor be able to collect from a purchaser as a part of the purchase price, money which has been spent in an effort to mislead that very purchaser in making that very purchase? I cannot see it.

"As previously suggested, I have taken this matter up without regard to formal pleadings, but for the reason that the public's rights seem to be largely involved, and much more liable to injury through the complainant's practices than through those of the defendants."

COMBINED COFFEE CHURN AND STRAINER—Which will hold the coffee grounds suspended, to be agitated by the boiling water, a perforated container permitting the water to pass through the solution. Patent 1668454. C. Y. Hake, 1450 Mt. Rise Ave., York, Pa.

COMPASS BUBBLE BOX—Having a cover glass with small dome thereon into which any bubble will rise and not interfere with the proper reading of the compass. Patent 1668425. F. G. Senter, 51½ Exchange Place, Portland, Maine.

TEMPLATE—By which it is possible to form singly various characters, such as the letters of the alphabet, digit numerals, and the punctuation marks used in writing. Patent 1668396. J. F. Carroll, Avoca, Wis.

HAIR WAVER—For imparting what is known as a permanent marcel wave, adapted for waving the hair on one side of the head at a single operation. Patent 1668430. H. Snodgrass, Box 135, Risbee, Arizona.

PRODUCING REFINED SUGAR—From cane juice molasses or beet root whereby at a slightly added cost per kilo refined sugars are produced directly, or at a still lower cost a lower grade of refined sugars may be produced. Patent 1668470. M. R. J. Schmid, c/o G. Brewer, Maipu 671, Buenos Aires, Argentina, S. A.

PAD FOR DECORATING—By which a decorator may simultaneously produce a design and stippling effect, on walls or freshly painted surfaces. Patent 1667841. F. F. Conwill, 5101 Kenmore Ave., Chicago, Ill.

DISPENSING DEVICE FOR PASTE TUBES—Capable of receiving collapsible tubes for tooth paste, or the like, of various sizes, and so compressing the tube that the paste may be dispensed without waste. Patent 1668296. C. C. Wells, 219 Sixteenth St., Hermosa Beach, Calif.

WINDOW CLEANER—Which may be used from the inside of a window for cleaning the outside surfaces thereof easily and quickly. Patent 1669293. O. Grossmann, 153 Ave. "B," New York, N. Y.

SMOKING PIPE—Formed of two flat sections laid one upon the other, and clamped together, may be readily disassembled for cleaning, repair, or storage. Patent 1669353. A. J. Sorbello, 365 Washington St., New York, N. Y.

KNOCKDOWN RECEPTACLE—Made of light gauge metal and having interengaging portions which may be secured together without the use of screws or nails, especially adapted for fruits or vegetables. Patent 1669300. J. W. Hunter, Box 962, Mobile, Ala.

APPARATUS AND METHOD OF PERMANENT HAIR WAVING—Wherein all parts of the hair are subjected to substantially the same amount of moisture as well as the same amount of heat. Patent 1668868. R. A. Porta, 309 Anza St., San Francisco, Calif.

DRAFT ARM FOR SODA FOUNTAINS—In which any liquid retained in the draft arm, which has previously been drawn from a cold supply, will remain cold while in the arm. Patent 1668635. T. De Stefani, c/o Liquid Carbonic Corp. 3100 So. Kedzie Ave., Chicago, Ill.

BINDER—A sectional binder capable of binding loose leaves together in such manner that there is no possibility of any being accidentally lost. Patent 1668813. W. J. H. King, c/o Union Lithograph Co., 741 Harrison St., San Francisco, Calif.

BULLETIN BOARD—Which may be set up in a store for displaying want advertisements as well as advertisements of the store and activities in the particular neighborhood. Patent 1669308. L. D. Smith, 9155 Chicot Court, Ozone Park, L. I., N. Y.

SECTIONAL SMOKING PIPE—The parts being so constructed that they are easily held together and may be readily separated for cleaning, the ducts are small, and the smoke is cool. Patent 1669869. D. Barker, c/o A. J. Sorbello, 365 Washington St., New York, N. Y.

TOILET KIT—In which a shaving apparatus and other toilet accessories, are securely re-

tained within a small compact case for transportation without danger of injury. Patent 1670177. J. N. Young, 179 E. 80th St., New York, N. Y.

JAR-CAP REMOVER—A gripping tool in which the jaws and operating handle are relatively adjustable for use upon jars or other objects of varying diameters. Patent 1670188. L. F. Castelli, 3787 Hudson Blvd., North Bergen, N. J.

SLACK TIGHTENER FOR PULLEY CLOTHES-LINES—By which the expansion and contraction of the line, may be readily adjusted by means of a specially formed webbed and notched plate, attached thereto. Patent 1670257. L. Hagen, 94 Fulton Ave., Jersey City, N. J.

HIGH-LIGHT PROCESS FOR PHOTO-ENGRAVING—Which comprises making half-tone and plain negatives from the same subject, retouching a print from the plain negative, making a new negative, and printing from the superimposed negatives. Patent 1670195. F. J. M. Garland, c/o Walker Engraving Co., 141 E. 25th St., New York, N. Y.

RUBBER ARTICLE—A hollow integral rubber article, having a hollow cardboard air-filled mandril completely embedded therein, the product being used as a bumper of any desired nature. Patent 1669854. O. T. Bugg, c/o Hotel Madison, 27 St. & Madison Ave., New York, N. Y.

SAFE CONSTRUCTION—Having an outer face plate so formed as to preclude the possibility of successfully breaking into the safe before an alarm is given. Patent 1669486. P. E. Pyle, c/o Schwab Safe Co., 1204 Columbia St., La Fayette, Ind.

CONCRETE WALL CONSTRUCTION—Comprising easily assembled forms having parallel guides supported and clamped one above another, adapted for vertically aligning a wall as it is built upward. Patent 1670057. C. M. Alley, 37A Barron Ave., San Mateo, Calif.

Hardware and Tools

JAR-HANDLING TOOL—For handling hot fruit jars when being filled, may be conveniently manipulated and adjusted, for applying or removing caps of various forms of containers. Patent 1667620. C. E. Bonge, c/o E. A. Houston, Niobrara, Neb.

APPARATUS FOR SHARPENING HANDSAWS—Adjustable to hold saws, and files of various lengths, in such manner that a file can be manually reciprocated to sharpen the teeth throughout the entire length. Patent 1666395. L. S. Miller, 1427 Santee St., Los Angeles, Calif.

TOOL FOR PLANING VALVE SEATS—Adapted to accommodate blades of various characters for planing simultaneously the inner and outer edges of a valve seat of an internal combustion engine. Patent 1667218. T. S. Purnis, c/o K. O. Lee & Sons, Aberdeen, So. Dak.

WATER-CLOSET SUPPORT—Which will be concealed in the wall and floor and may be adjusted to the varying sizes of fixtures of water-closets, sinks or baths. Patent 1667593. R. T. Frye, Box 142, Blauvelt, N. Y.

COMBINATION PADLOCK—Constructed to effect a secure locking, and provided with means for changing the combination, to prevent or make difficult the opening by unauthorized persons. Patent 1668441. F. O. Willey, c/o Dr. P. R. Mort, Teachers College, Columbia University, New York, N. Y.

VALVE—For spigots as well as general use, wherein the valve key will be reciprocated, while the operating member thereof will be rotated. Patent 1668455. C. H. and A. P. Horn, c/o A. P. Horn, 40 Elmhurst Ave., Elmhurst, N. Y.

PIPE GRIP—Of the type embodying a gripping member and a rope, the arrangement being designed to prevent displacement of the gripping rope. Patent 1660322. F. L. Boyd, c/o E. N. Collidge, 425 Ford Building, Great Falls, Mont.

SELF-LOCKING DEVICE FOR COUPLINGS—

For use in connection with drilling tool joints, where it is necessary that the joints be locked against accidental uncoupling on removal from the well. Patent 1669186. F. S. Bunker, P. O. Box 1147, Compton, Calif.

VISE—Adapted to be held to a work table or the like, and in which the jaws are turnably adjustable about the axis. Patent 1670194. F. A. Fontaine, Auburndale, Mass.

REMOVABLE VALVE-STEM PROTECTOR—Which may be placed around the stem without removing the hand-wheel, will prevent corrosion, preserve the packing, and prevent rust when the valve is closed. Patent 1670241. W. W. Conner, 30 Church St., New York, N. Y.

ARMOR-CUTTING TOOL—Adapted to sever the armor or conduit of an electric cable formed of spirally wound interengaging metal coils without danger to the cable. Patent 1670250. F. Froeschhauser, c/o Triangle Conduit Co., Dry Harbor Rd. & Cooper Ave., Brooklyn, N. Y.

DEVICE FOR APPLYING BOX STRAPS—For simultaneously deforming portions of the overlapped ends, in such manner that the strap will be in rigid engagement throughout its entire length. Patent 1670201. F. L. McGary, Hardinsburg, Ky.

SAW SET—Wherein the saw set itself is positioned in operative relation to the saw blade, and a blow struck with a hammer by the operator. Patent 1670949. G. Anderson, 510 Broadway, Seattle, Wash.

Heating and Lighting

HEATING DEVICE—A gas burning heater which may be readily and safely installed in the floor of a room, and regulated for an even distribution of heated air. Patent 1668367. L. F. Clausen, 3588 20th St., San Francisco, Calif.

HEATING APPARATUS—A portable electric heater, including means for not only distributing the heat to various parts of the room, but for intensifying the heat before distribution. Patent 1668417. S. M. McConnell, Box 3054, Tampa, Fla.

HEATING ELEMENT—An electric apparatus, adapted to raise the temperature of water in a hood shaped container to a predetermined degree, for use in chicken brooders. Patent 1668477. H. Westergaard, Solvang, Calif.

AUTOMATIC FUEL-OIL SUPERHEATER—For pre-heating fuel to be used in a furnace for the purpose of heating water and generating steam in hot water or steam heating systems. Patent 1667713. G. Baker, 708 University St., Seattle, Wash.

OIL BURNER—Designed to produce a maximum breaking up or atomization of heavy oils, and a thorough mixture of the atomized oil with air prior to its ignition. Patent 1669810. C. F. Clapham, 6745 Ridgeland Ave., Apt. 3, Chicago, Ill.

Machines and Mechanical Devices

PISTON AND PISTON-RING CONSTRUCTION—In which thin edged flexible piston rings are carried in V-shaped grooves, and held by means of spring tension against the walls of the cylinder. Patent 1666966. R. G. Hill, 251 East Union St., River Falls, Wis.

BOILER-TUBE CLEANER—Which may be projected into the flue and then expanded to the diameter so that the material coating the pipe may be withdrawn. Patent 1667169. P. Ruck and M. Schutz, c/o Samuel Lewis, 2 Broome St., New York, N. Y.

WAVE MOTOR—Mounted in respect to the water so that the mechanism may be operated by the raising and lowering of floats, to produce power from wave motion. Patent 1667182. M. Hegge, 128 South Mountain View Ave., Los Angeles, Calif.

UNIVERSAL JOINT—Which will not be subject to undue strains, the parts being so correlated as to render them immovable circumferentially.

to set up undue wear. Patent 1667455. E. G. Burns, 2763 Fruitdale St., Los Angeles, Calif.

SEALING VALVE FOR GAS LINES—Adapted to be installed when sealing off a supply line, at a point where the line is connected at an angle to a distributing house line. Patent 1667084. H. B. Hatton, 725 Cordova Ave., Glendale, Calif.

APPARATUS FOR MANUFACTURING MATCHED FLOORING—Including side and end matchers, between which the flooring strips are conveyed for tonguing and grooving, and saws for removing knots and imperfections. Patent 1667668. C. R. McLaughlin, Deridder, La.

DERRICK—Of the knock-down type, formed of a plurality of elements which are interchangeable and may be readily assembled or disassembled without destruction of any part. Patent 1667582. N. B. Briggs, c/o Western Iron & Foundry Co., Wichita, Kans.

VALVE—Which is provided with means whereby the packing employed therein may be removed without shutting off the valve. Patent 1667203. H. C. Harris, 1544 Central St., Denver, Colo.

DEVICE FOR CEMENTING WELLS—A novel form of device which makes provision for the escape of gas in the cementation of one-string wells, also avoids agitation of the cement. Patent 1667649. A. Boynton, 1800 San Pedro Ave., San Antonio, Texas.

PRESSING MACHINE—Particularly adapted for use in clothing factories, for pressing and smoothing down the edges, seams, and other thickened portions of a garment. Patent 1668501. S. Goldstein, 55 East 8th St., New York, N. Y.

AUTOMATIC VALVE FOR GAUGES—A construction wherein a tank gauge may be caused to properly function without danger of losing any of the mercury forming part thereof. Patent 1667877. R. Star, 84 Flushing Ave., Brooklyn, N. Y.

CARDING-MACHINE-APRON OILER—Having automatic means for constantly distributing to the surface of the moving belt or rub apron the proper amount of oil to keep the apron pliable. Patent 1668433. F. H. Thomasson, c/o Unity Spinning Mill, Lagrange, Ga.

CLEANING AND COATING MACHINE FOR PIPES AND THE LIKE—Operable to receive and continuously feed pipe therethrough in such manner that the surface cleaning and coating may be automatically performed, and with great thoroughness. Patent 1668265. H. S. Christopher, 607 West 1st St., Los Angeles, Calif.

MANTLE OF MOLDS FOR CASTING STEREOTYPE PLATES—Having a comparatively large air chamber in rear of wall carrying the matrix, and a shallow water chamber between the air chamber and back wall. Patent 1669316. C. Winkler, c/o Winkler, Fallert Co., Berne, Switzerland.

APPARATUS FOR EXTRACTING OIL FROM SHALE—Comprising a gravity chute for feeding shale to a retort, and means extending into the retort for drawing off vapors distilled therein by the heat of combustion. Patent 1668820. W. Rhodes, 578 Bancroft Ave., San Leandro, Calif.

CIRCULAR KNITTING MACHINE—Having means for automatically repeating the doubling of the stitches in courses spaced predetermined distances apart in the fabric according to the length of the stocking. Patent 1669296. A. F. Harris, c/o Samuel Owen, 361 Pearl St., New York, N. Y.

WINDMILL—Which produces a suctional power resulting from a partial vacuum, greatly increasing the amount of power for operating the wind wheel in much lighter winds. Patent 1670186. I. M. Brandjord, 517 6th Ave., Helena, Mont.

HITCH FOR LAWN MOWERS—For attaching a lawn mower in front of a tractor, permitting the use of mowers of different widths, and allowing a maximum of flexibility in turning. Patent 1669287. S. W. Shaw, Galeburg, Kansas.

APPARATUS FOR THE MANUFACTURE OF FANCY KNITTED FABRICS ON CIRCULAR KNITTING FRAMES—Having means whereby the threads may be instantaneously reversed to produce variable designs in different colors, or vertical stripes, visible on the face or back. Patent 1670208. G. Nigra, c/o G. Capuccio, via Arsenale N. 17, Turin, Italy.

UNIVERSAL JOINT—Having a pair of co-acting forks and an articulated ring so connected as to properly transmit power while permitting a limited motion toward and from each other. Patent 1670175. T. S. Wikoff, 306 E. 2nd St., Plainfield, N. J.

LUBRICATING GUN—For liquid greases, so constructed that a powerful thrust of the lubricant ejecting piston is rapidly obtained by a rack and pinion movement. Patent 1670210. F. W. Parker, 957 Hayes St., Apt. 8, San Francisco, Calif.

RADIATOR - TRANSPORTING APPARATUS—Which may be readily applied to a radiator so that the same may be manually lifted and carried by mechanics, or wheeled by one mechanic. Patent 1670196. J. B. Heiser, 423 Park Ave., Williamsport, Pa.

Medical Devices

REVOLVING BED—Adapted for use in moving a patient to an inclined or any desired position, for permitting a wound or other injury to be readily worked upon. Patent 1667982. R. W. Pearson, 70 Fourth St., Laurium, Mich.

TRUSS—Having a pad-supporting element constructed of a yieldable tubing which prevents marking of the body and is therefore particularly adapted for use upon infants. Patent 1669354. C. A. Soriano, 195 Montrose Ave., Brooklyn, N. Y.

MENSTRUAL SPONGE—A readily applied device for efficiently controlling the flow in a sanitary and comfortable manner, and for the prevention of soiling or staining clothing. Patent 1669295. A. Hallenberg, c/o Fargo Clinic, Fargo, N. D.

Prime Movers and Their Accessories

IGNITER FOR INTERNAL-COMBUSTION ENGINES—An abrasive wheel, and a co-acting contactor engagable therewith when ignition period arrives, for producing a stream of sparks in a downward direction. Patent 1666967. H. A. W. Howcott, 320 Kernan Bldg., 317 Fla. St., Baton Rouge, La.

INTERNAL-COMBUSTION MOTOR—A construction which is practically vibrationless because of the absence of pivotal connections between the piston rods and pistons, slidable valves eliminating the usual noisy tappets. Patent 1667213. P. Marchetti, 735 Montgomery St., San Francisco, Calif.

Pertaining to Recreation

GAME BOARD FOR GAME PIECES AND SURFACE PROJECTILES—Requiring the skillful manipulation of the surface projectiles in knocking the game pieces of another player from their respective characters, without disturbing his own. Patent 1666474. O. D. Sorell, 1122 Ogden Drive, Los Angeles, Calif.

GAME—Comprising a casing and partitions forming a plurality of compartments through which a ball passes, and a bunker and trap for making the game more difficult. Patent 1668873. J. C. Sheller, 410 St. Charles Rd., Haywood, Ill.

FISH LURE—For trolling or casting, so constructed that when drawn through the water it will have a snappy, diving, zig-zag movement simulating an injured minnow. Patent 1669350. J. A. Sebenius, 960 4th St., Bremerton, Wash.

ARTIFICIAL BAIT—Constructed to prevent the hooks from engaging weeds, but requiring no

spring action for projecting the hooks when the bait is struck by a fish. Patent 1670174. H. P. Wiersma, c/o E. J. Babbitt, Holland, Mich.

MECHANICAL TOY—Which comprises a frame, within which is a rotatable drum propelled by the upward and downward motions of a toy figure, while swinging backward and forward. Patent 1670,249. E. E. France, Box 398, Holyoke, Colorado.

Pertaining to Vehicles

AUTOMOBILE STEERING MASTER—Mechanism in combination with the axle, by means of which a car is held steady in a straight ahead position, and righted after a turn. Patent 1666386. C. A. Johnson, 2945 34th St., Sacramento, Calif.

TRANSMISSION STAND—A tilting holder for adjustably supporting and clamping any conventional type of automobile transmission case, in proper position for repair, or other work. Patent 1667616. H. J. Wright and G. Shirk, c/o H. J. Wright, Box 784, Waynesburg, Pa.

GLARE SHIELD—Which will protect the eyes from the glare of oncoming headlights, yet will enable the driver to take full advantage of the increased lighting effect. Patent 1667658. H. G. Egle, 131 2nd Ave., Long Branch, N. J.

SUSPENSION DEVICE FOR VEHICLES—In which the rear springs are concealed in the interior of the vehicle frame and are supported by the cross-pieces of the frame and the thrust tube. Patent 1668423. C. Schaeffer, c/o C. Bletry, 2 Boulevard de Strasbourg, Paris, France.

RESILIENT SUPPORT FOR CUSHION SEATS—Which includes a stationary frame and a seat rest, also a compartment for the storage of tools or other articles, especially designed for vehicles. Patent 1668473. A. Weickman and C. S. Olmsted, c/o Albert Weickman, 218 E. 59th St., New York, N. Y.

BRAKE-OPERATING MECHANISM—Which is adapted to effect a quick and positive application of a braking action on each of the front wheels of an automobile. Patent 1668436. G. Walker, General Delivery, Russell, Ky.

GREASE CUP—Greatly facilitating the application and distribution of the lubricant to the entire parts of the machine upon which it is mounted, designed for use on automobiles. Patent 1668510. T. P. Martin, Oklahoma City, Okla.

VEHICLE SIGNAL—Adapted to be attached to a windshield frame, or like support, to extend laterally, and indicate the direction the car is about to take. Patent 1669332. J. B. Gabrielson, La Center, Wash.

AUTOMOBILE HOOD LATCH—A concealed automatically-acting latch means, which may be readily attached to any standard car, to prevent unauthorized opening of the hood. Patent 1669356. E. A. Stevenson, 468 Walnut St., Elizabeth, N. J.

DEVICE FOR FACILITATING THE REMOVAL OF SHACKLE BOLT—From automobiles and similar vehicles, the device consists of a standard with threads, and an adjustable U-shaped clamping device from engagement with the springs. Patent 1669352. H. J. Sloan, c/o Haywood Electric Power Co., Waynesville, N. C.

ATTACHMENT FOR MOTOR EXHAUSTS—In the nature of a sounding device, whereby an ordinary layman can tell by the particular sound whether or not the engine is operating properly. Patent 1670200. W. A. Luukkonen, 216 E. 3rd St., Brooklyn, N. Y.

LUBRICATING DEVICE—In which only a predetermined quantity of oil or grease is forced into the various parts of a car, may be quickly secured to standard automobiles. Patent 1669615. C. F. Hooper, 549 W. Washington Blvd., Chicago, Ill.

SIGNAL—A permanently attached, or detachable, device to be worn on a glove, or semi-glove, and used as a signal by automobile drivers. Patent 1670176. L. C. Woolery, Box 1804, Bisbee, Arizona.

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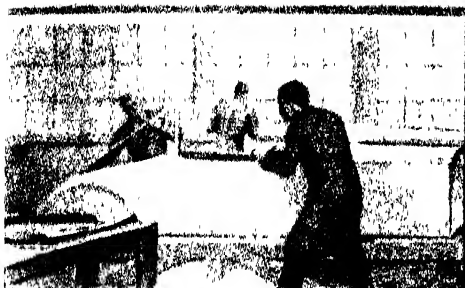
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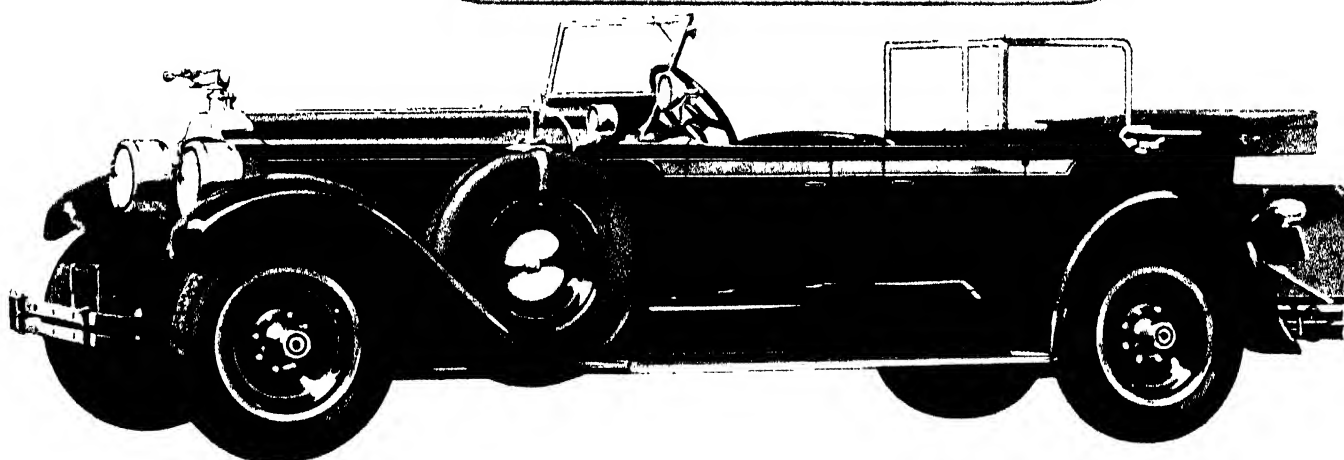
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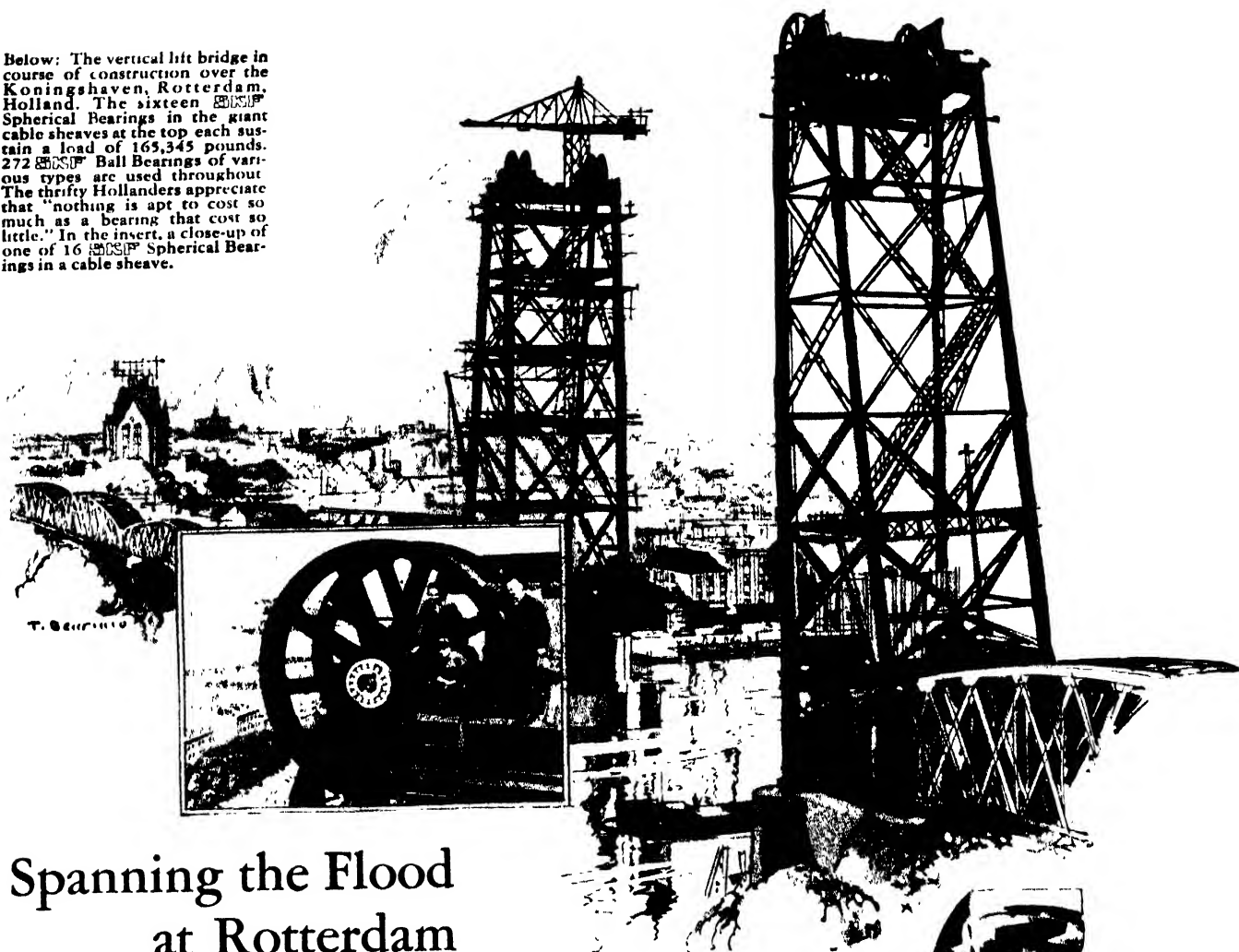
PRIMITIVE AUSTRALIAN BLACKS

NAVAL ADEQUACY—Part I

FARM AID FACTS



Below: The vertical lift bridge in course of construction over the Koningshaven, Rotterdam, Holland. The sixteen SKF Spherical Bearings in the giant cable sheaves at the top each sustain a load of 165,345 pounds. 272 SKF Ball Bearings of various types are used throughout. The thrifty Hollanders appreciate that "nothing is apt to cost so much as a bearing that cost so little." In the insert, a close-up of one of 16 SKF Spherical Bearings in a cable sheave.



Spanning the Flood at Rotterdam with 288 **SKF** Bearings

IT'S a far, far cry from the new vertical lift bridge over the Koningshaven at Rotterdam, but there's a story behind it that echoes wherever anti-friction bearings are used—even on *this* side of the Atlantic.

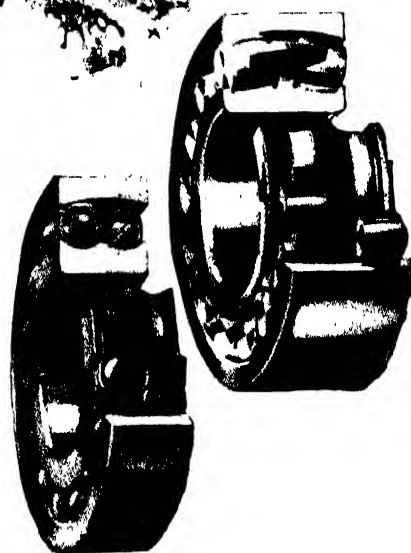
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A SCIENTIFIC RESTORATION OF THE GREAT TAR-POOL AT RANCHO-LA-BREA, NEAR LOS ANGELES

The giant sloth of South American origin is about to become mired in the tar. The saber-toothed tiger will follow, and next to be trapped

will be the great extinct condor. In the background is the huge imperial elephant or mammoth, frequently too intelligent to be trapped

Extinct Animals of California

Fossil Remains of Creatures Which Lived Thousands of Years Ago Have Been Exhumed in California

By CHARLES H. STERNBERG, A.M.

Member, Paleontological Society of America; Society of American Vertebrate Paleontologists

OWING to the kindness of Dr. G. Dallus Hanna, Curator of Paleontology of the California Academy of Sciences, I was directed to the deposit of extinct mammals, birds and reptiles at McKittrick, 35 miles west of Bakersfield, California, in the oil fields. I received authority from Mr. Hall, manager of the Midway Petroleum Company, on whose land the deposit lay, to make the necessary excavations. He also allowed me to use a house on the lease, half of which I turned into a laboratory while I lived in the other half with my wife.

THE University of California had already done work here, taking out a mastodon skull and many other bones. I began work in 1925 and exhausted the quarry the last of October, 1927, exploring carefully the area on the northwest side of the highway. Here I was so fortunate as to discover a great drift of bones 50 by 60 feet in area, and about two feet thick. These bones were filled with asphaltum, from a flow of quite recent time.

When I collected the specimens I took them to my work-shop and washed the bones in distillate to remove the tar. When they were dry I brushed them clean, then soaked them in dilute shellac to prevent their falling to pieces. I then mended the broken ones with a cement made of gum arabic and plaster of Paris. I was thus enabled to send the prepared material

to Dr. Chester Stock of the California Institute, at Pasadena, for scientific study.

When I went to the locality, I was led to believe that it resembled the one at the Rancho-la-Brea tar-pools—that great trap where, during Pleistocene and post-Glacial times, many animals had been caught. It has been in operation for many thousands of years, and hundreds of saber-toothed tigers, dire wolves, horses

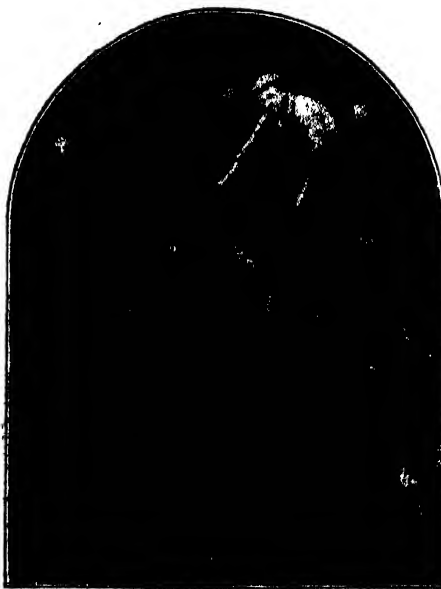
and many other species have been caught in the tar, from which there was no escape.

All the skeletons found at Rancho-la-Brea were disarticulated, the bones indiscriminately mixed together. In my quarry, however, I found that the animals had been carried in by water, and thus many articulated skeletons of carnivores and herbivores lay mixed together, besides countless thousands of scattered bones of birds and mammals.

I FOUND a Great Bison, much larger than the recent buffalo. The horn cores measured 44 inches from tip to tip. It was 11 feet from the end of the chin to the base of the tail.

The hump was 18 inches high. The horn cores were at right angles to the skull, with tips turned back. The head lay under the hump, showing that the animal was carried to his burial by water. After death he had sunk to the bottom of the river. Then the gases filled the body and floated him. He was finally swept into an eddy and there whirled around until vultures had liberated the gas, when he sank to the bottom.

I found horses and camels, llamas, antelope, bison and saber-toothed tigers, wolves, lions and bears, lying together—the first time after an experience of 60 years in the fossil fields, that I have found carnivores and herbivores mingled together in death.



Courtesy of Fossiliferous California

FOSSIL MAMMOTS—LA-BREA

Bones of the imperial mammoth, largest of all elephants, which was trapped in the tar

The same series of events I have mentioned above in connection with the Great Bison must have been the fate of all the animals whose articulated skeletons I found here, of which about 20 are in good enough condition to be mounted. There were also countless scattered bones of mammals and birds mingled with the others, showing that a great flood had brought down the drowned animals and the others whose bones lined the shore of the river. All were picked up and carried to this great cemetery of God's buried dead.

I FOUND the skeleton of a mastodon, nearly complete, with the exception of the skull; also 12 skulls of the extinct horse (the western horse). The skulls measured from 25 to 30 inches in length. I found young and old horses, one showing the permanent teeth gradually pushing out the worn milk dentition.

Here too, I secured a fine skeleton of a large camel, as large as the Asian variety. The camels and horses



Courtesy of Peabody Museum

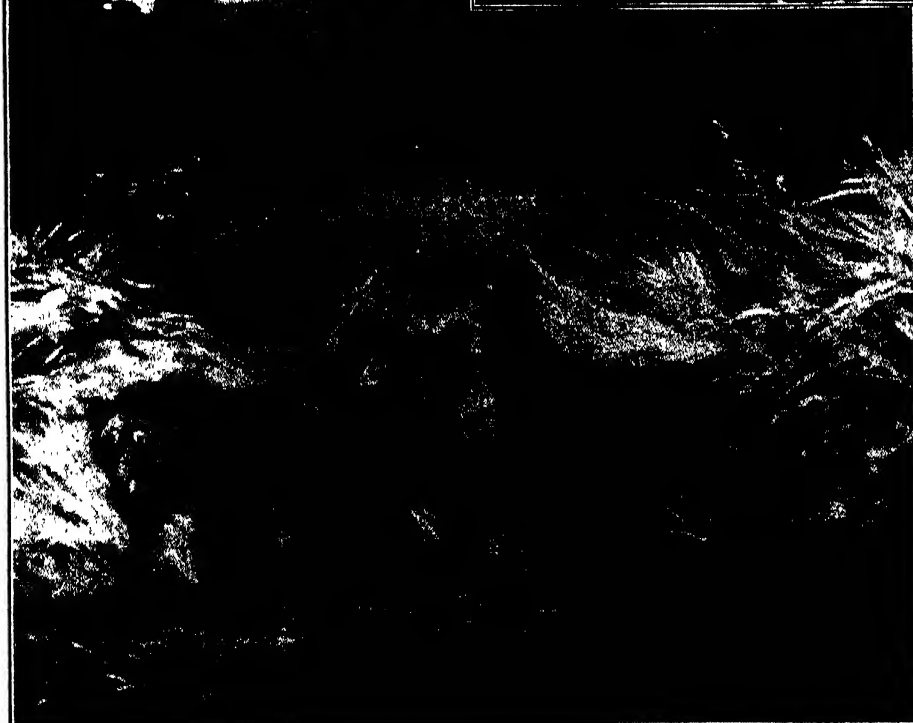
TAR AT LA-BREA

Only in times of severe drought did the animals risk the deceptive surface water over the tar

originated in North America and became extinct during the Pleistocene. I found two llama skulls with enough of their skeletons to make open mounts. They are closely related to the South American llama. Then, too, I found a new species of a musk ox and a couple of antelope exactly like our northern prong-horn.

I SECURED only six dirus wolves. These extinct wolves are very abundant in the Rancho-la-Brea tar-pools at Hollywood. They were much larger than the grey or timber wolf of which later species I secured 10 skulls and several skeletons.

I also discovered 16 coyotes showing a much closer approach to recent times than those of the Rancho-la-Brea tar-pools at Hollywood. I procured a small and a large lion. The skull of the latter was 17 inches long and 11 inches high. Then I discovered a brown bear skull and skeleton, and a short-nosed bear which is now extinct.



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DIRUS WOLVES AND WESTERN HORSES

The western fossil horse differed from modern horses. Horses later became extinct in the New World, although their whole evolution had taken place there. The Spaniards re-introduced them



Painted under the direction of Henry Fairfield Osborn, by Charles R. Knight for the Hall of the Age of Man. Reproduced by permission of the American Museum of Natural History. Copyrighted.

THE EXTINCT GIANT CAT STALKING A CAMEL-LLAMA

The giant cat, proportioned like a lion, far exceeded in size the living lions. The camel shown was closely related to the South American llama. The camels, like the horses, evolved in America

I found only one saber-toothed tiger, although they were very abundant in the Rancho-la-Brea tar-pools. I found also badgers, a skunk, fox, jack rabbits, rats and mice. There were countless birds, not many perfect skulls, but thousands of scattered bones. Among them was the great extinct vulture (larger than the California condor of today), many waders and swimmers, land birds and so forth. Dr. L. H. Miller of the University of California at Los Angeles, after looking over a very small part of my collection, identified 100 species.

WE can imagine a wonderful fauna during the time these animals lived. Quantities of sticks and branches of trees are associated with the bones, as well as beetles, a few land shells, four turtles and other material. I got only one specimen of a sloth. They were dying out. Numbers were found at the Rancho-la-Brea tar-pits.

The material in which these animals were buried was very fine clay. Below the tar that extended downward only about two feet the clay was filled with water, impervious to asphaltum. Scattered through it, however, were many pockets, usually round, that passed through the bone-drift above and extended down through the clay—in one place 17 feet below the highway. These pockets were from an inch to two feet in diameter, but three which were on the margins of the bone drift were several feet in diameter, wide at the top and narrow at the bottom. In one of these I found over 60 jack-rabbit skeletons, countless jumping rats, mice, and many birds.

I felt confident from the first that these pockets and their contents were of recent time, because they were filled

with sand like that on the surface, through which asphaltum from the mass on top had melted in hot weather and run down as far as they went, while there was none in the clay on either side. In one case I found a skull of a horse with nose down, as if it had fallen into a hole from the drift above.

Dr. Chester Stock, vertebrate paleontologist of the California Institute of Technology at Pasadena, in whose employ I was, requested me to make further excavations at the University

Quarry, across the highway. Here I discovered a pocket similar to the one in my quarry, and some 10 feet below the surface. It was full of sand, jack rabbits, rats, mice, many bird bones, roots of plants, sticks, and beetles, all thoroughly saturated with asphaltum from above. Here I found the arch wing bones of a bird, held together with cartilage.

DR. CHANEY, Research Associate in Paleobotany of the Carnegie Institution of Washington, found the roots in these pockets to belong to plants of post-Glacial geological age and this establishes that the pockets belong to the same epoch. This shows how easily one may be deceived; the ordinary observer would have thought that all the animals and birds found belonged to the Pleistocene or Glacial Epoch, as the horse, camel and other Pleistocene animals were abundant here. The extinct animals gradually disappeared and recent ones took their places.

As we do not know when Pleistocene time ends and post-Glacial time begins, this great collection will help solve the problem. The great scientific value to the world is the preservation of some 20 articulated skeletons.

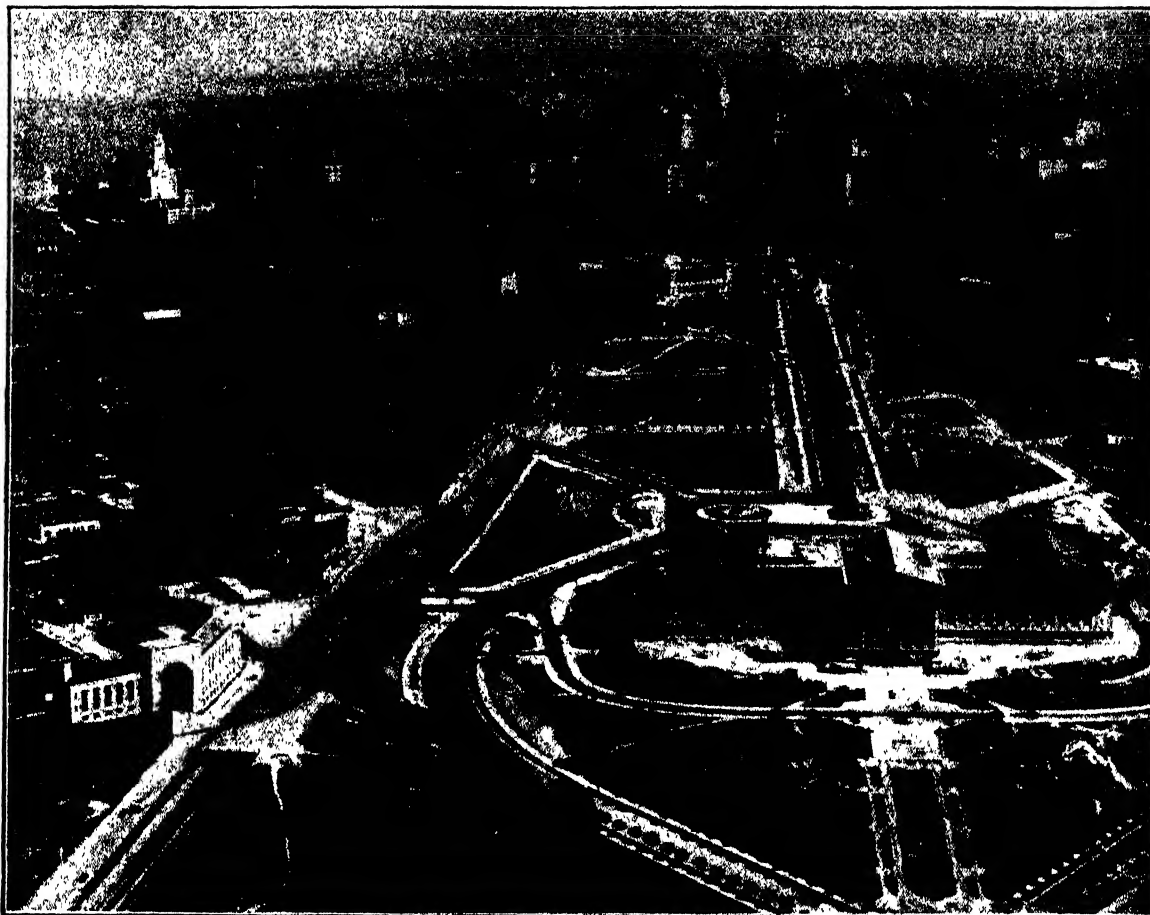
Q What sort of a world does a dog live in? Does a dog hear, see and react like a man? Scientists have learned that a dog's psychological world is not the same as man's. In an early issue a noted animal psychologist will elucidate.



Courtesy Placeres California

AT WORK IN THE LA-BREA PITS

McKittrick is 180 miles northwest of La-Brea, but the two localities have much in common; La-Brea is early Pleistocene, McKittrick more recent. Most of the fauna was the same in both places



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WHERE BEAUTIFUL ARCHITECTURE REIGNS SUPREME

In the "Golden Triangle," where once squalor and poverty held sway, the new Art Center of Philadelphia now stands. Here will be assembled the treasures of the Pennsylvania Museum, and famous paintings from various private collections

When Art Replaces Ugliness

A Section of the Slums of Philadelphia Has Been Eliminated, and in Its Place Now Stands an Architecturally Beautiful Art Center

WITH an art history dating from the time of Benjamin West (the first American artist to win recognition abroad) and known throughout the world for its private collections, Philadelphia is contemplating an Art Center in which the chief element will be a museum now rapidly nearing completion. This will assure the assembling under one roof of the treasures of the Pennsylvania Museum, and the famous paintings of various private collections already acquired or promised as final disposal.

The new Museum looks down an avenue that will rival the Champs Elysées and surveys an area from which all unsightly buildings are to be swept to make way for gardens and for new structures of beautiful design to house Philadelphia's venerable institutions of culture.

The Parkway, its main approach, is

another of the world's great boulevards in the making. The Museum and the Free Library are but two of the splendid structures which will line this avenue. Sites have been reserved for the future homes of the American Philosophical Society, the Rodin Museum, the Franklin Institute, and, in front of the Museum, for the Pennsylvania Academy of the Fine Arts and the Museum's School of Industrial Art. Of this great cultural and civic center the new Museum will be the chief architectural feature.

GUARDED for all time against the city's encroachment by the Park and the Schuylkill River on three sides and the Parkway stretching out before it, the new building, like the temples of old, has been built for the ages. Minnesota dolomite, a most enduring marble, is the material of its massive walls. The stone, a flushed yellow,

recalls the beauty of the Parthenon, as do many of the other architectural features.

Built as a unit, it thus becomes the largest structure of its kind and its unique arrangement is designed for the most effective display of present treasures and future acquisitions.

Objects of art, placed in authentic rooms of the period that produced them, will live in the atmosphere of their own time and place, as they cannot live in miscellaneous collections.

Groups of period rooms arranged in historic and geographic order will invite the visitor to walk through the pageant of historic beauty of all times and lands. The entire principal exhibition floor will be given over to the realization of this ideal. The main galleries for each nation and age will be flanked by an unbroken series of 37 period rooms and backgrounds. Here the visitor can live again through the

ages of Oriental, European, and American art.

Authentic period rooms from the fast vanishing mansions and fine old homes of America and England have been provided by the Pennsylvania Museum and its friends. Furniture and other objects of decorative art to perfect the historical settings are also available from the collections which the Museum has built up during the last 50 years.

But interesting as are the collections, from the layman's standpoint it must be said that the architectural effects are the most unusual, for these fittingly include the long disused principles of pure Grecian architecture which have made the Parthenon the envy of all builders.

There is not a straight line in this 11,000,000 dollar structure. Columns are slightly off the vertical. Walls are imperceptibly bulged or bent. What seem to be unvarying lines are slight curves. There are 40 columns in the new Art Museum, and each group leans toward the center as well as toward the building, the variation from the perpendicular being about four inches in the 60-foot height of the column. These rows of columns are so finely pitched that a series of straight lines drawn through the center of each column would meet in the air about two and one half miles above the portico. A 125-foot wall in the Philadelphia structure varies five inches at the point of greatest curvature and even the terra-cotta roof is built slightly concave in order to register a perfectly straight line to the eye.

THE architectural refinements are based upon the work of the late Professor W. H. Goodyear of the Brooklyn Institute, and a scale model was built in accordance with his markings on the blue prints.

As each of the 40 columns was constructed of from 16 to 20 drums and they were not made up of precisely similar sections, exacting accuracy was necessary here, as in the walls, in order to avoid re-cutting and resetting. What Professor Goodyear worked into the design were changes similar to those made by Greek architects to satisfy the eye's demand for apparent and not actual straight lines. The line of a building over a row of columns appears to sag when made level. This has been corrected by a rising curve. A column that is perfectly cylindrical appears to be pinched at a place about half its height. To overcome this apparent thinning, a faint bow is given at a place about one third up.

The Greeks had noticed that columns placed at angles against a background of sky appeared smaller than others in the portico. To correct this error of vision there was a slight increase of diameter of columns at the angle

of the building. Still another optical illusion occurred in the columns. A colonnade that was perfectly vertical seemed to spread. As a correction the Greeks inclined the axes of the columns ever so slightly toward the center of the portico.

The first use of such architectural corrections is found in the atrium of the Temple Medinet Habou in Luxor; an edifice built about 1500 B.C. This knowledge was carried over to Greece and had its finest development in the Athenian Parthenon which was built about 450 B.C.

Later Greek and Roman builders stopped correcting these apparent architectural deformations because civilization became increasingly commercial and would not stand the expense.

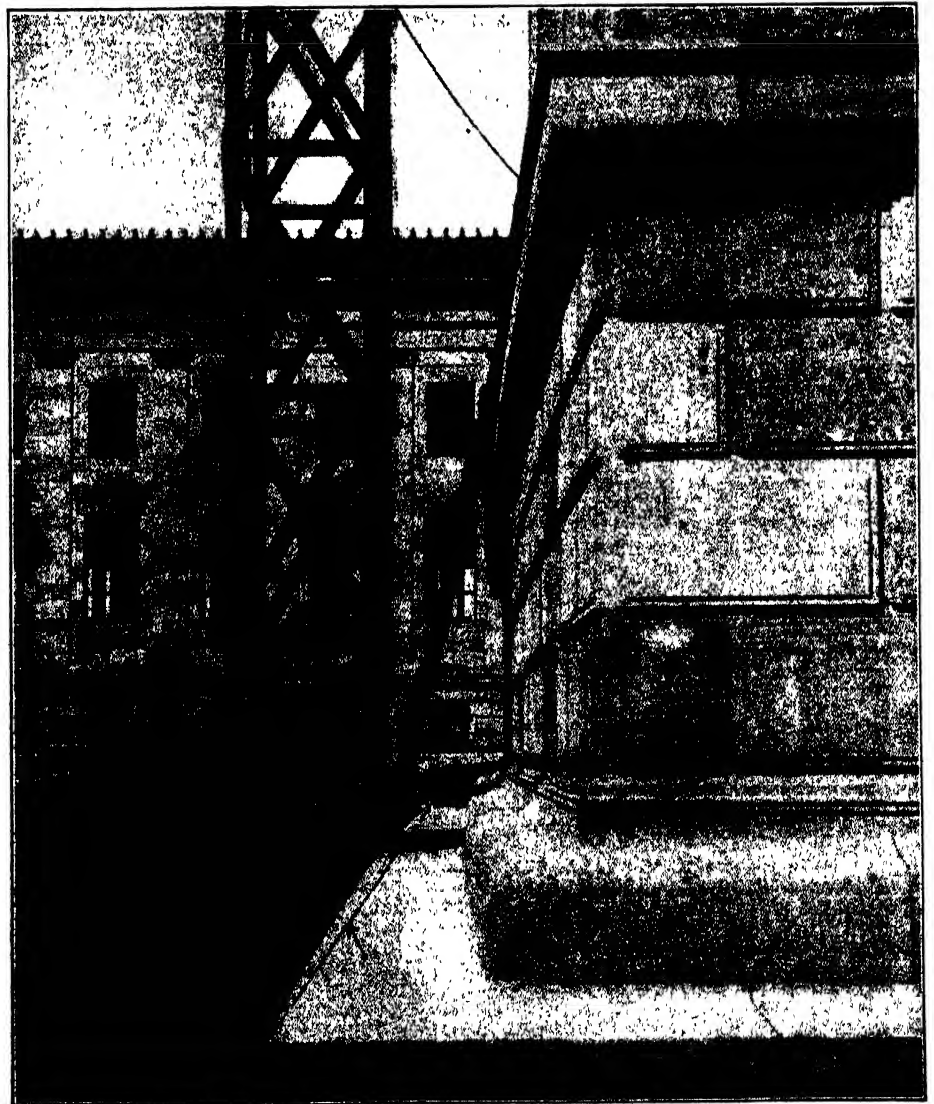
The architects of Egypt also had observed this curiosity of optics and with great care built the cornices of certain of their temples so that they actually were curved. It is an interesting fact that while the Greek curves are traced in vertical planes the Egyptian arcs

are contrasted in horizontal planes.

The use of curves instead of straight lines is not the only significant refinement in the Philadelphia structure. We usually associate Greek art with the cold classic walls and plain but ponderous columns, but here the Greek use of color has also been added to the design. For the first time since classic days pigments have been used to brighten solemn walls and columns.

SINCE the use of gay decorations was a lost art, experiments had to be made to gage the visibility of flashing shades at a distance. All models were made to scale, cast in plaster, treated with color and gold, and then taken out of doors and hoisted 50 feet. It was found that radical changes had to be made in order to have the colors blend properly from afar.

The four acres of terra-cotta roof are glazed from deep blue to bluish-green and even the walls have pleasing shades of stone. Harmonious color combinations were worked out in advance. The stones were numbered



NOT A STRAIGHT LINE IN SIGHT

Taking their cue from the famous old Greek architects, the designers of the new Philadelphia Art Center have produced a structure pleasing to the eye, no matter how viewed. Note the dot-and-dash line indicated by the arrow, which shows the accurately calculated curvature of the building



INDIRECT LIGHTING

The lighting systems employed in the interior of the Art Center approach daylight in their effects. Above is illustrated one corner of a room, showing how reflected light is employed

as they came out of the quarry and they were set in position in the walls which had been spotted in advance.

The Museum is 551 feet wide and 423 feet deep. There are three floors above the basement and it is the largest building in the world built as a unit for museum purposes.

One of the modern refinements which adds a subtle but very important feature entirely in harmony with the ensemble is the method and mechanism of lighting.

Here the illusion of natural daylight is obtained by employing only Mazda "daylight" incandescent lamps. These lamps with their blue glass bulbs correct the light of ordinary bulbs to a color not as coldly white as outdoor daylight but to a hue which approximates that of natural light indoors which has been mellowed somewhat by window draperies and the tone of the interior decorations of the room. Nearly 1000 lamps are used to light the portion of the Museum now completed. The lamps range in size from 60 to 1000 watts, each definitely and designedly contributing its part in the lighting ensemble.

SOME are used in floodlight projectors above artificial skylights, others in coves concealed in ceiling ledges, while others are part of artificial windows but not one is exposed to view.

The large temporary galleries along the north side are partially ceilinged with glass, through which comes a glow of light, soft and diffused. Above each skylight section is a large housing painted white inside, which reflects back from many "daylight" lamps within. But little dependence, however, is placed on the skylight for the

strong, discerning light that is essential for the gallery walls for only sufficient light comes through the skylight to make the ceiling softly luminous.

Bounding the glass ceiling area on all four sides are beams dropped a foot below the ceiling and extending both lengthwise and crosswise of the rooms about five feet from the walls. To all appearances these beams are simply supporting members of the ceiling structure but their primary purpose is to form the housing for the source of the gallery wall illumination. The sides of these drop beams toward the walls are of stippled glass sections behind which are concealed projectors so ad-

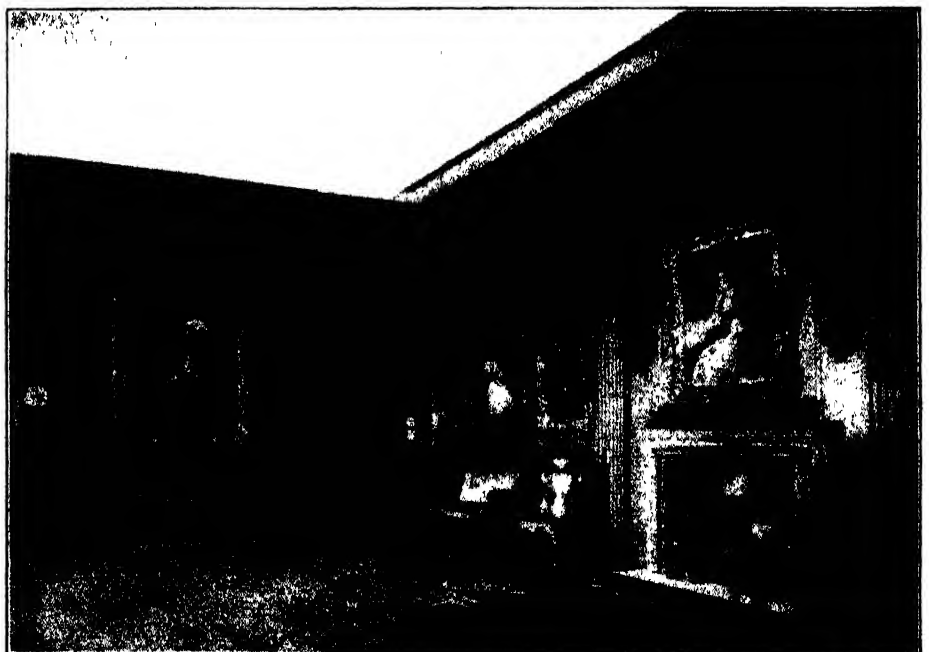
justed as to throw a flood of white light on the picture area. These projectors are spaced every two or three feet along the beams, and are mounted on swivel joints for aiming as desired. Each plays its own part in lighting a definite portion of the wall area.

Perhaps the most unusual treatment is manifest in the 10 period rooms—particularly so if we seek to emphasize the departure from architectural precedents so increasingly necessary if the full potentiality of lighting is to be gained.

THESE rooms are originals, four English, four American and two Pennsylvania Dutch, transplanted with meticulous care to this new stately building which crowns Philadelphia's Acropolis. There is the golden brown fumed oak wainscoting of Sutton Scarsdale with the tragic deathless loveliness of Lady Hamilton looking down from one great picture and other Romneys, Gainsboroughs, and Raeburns of the McFadden collection accompanying it.

When these rooms were reconstructed within the museum, a small space was provided between the museum walls and the outside wall of the rooms. This allows some diffusion of natural daylight to filter in through the inner windows, but by dropping a white curtain outside the room windows, a soft diffused artificial light is reflected into the room. Daylight lamps are hidden outside the window and direct their light to this curtain.

With its historic past and future potentialities, which have not been covered in this description, Philadelphia may well look forward to maintaining one of the great museums of the world.



ONE OF THE MANY PERIOD ROOMS

Furniture, paintings, and the like, from various periods are grouped separately, so that segregation is complete. In this room, as in others, the various pictures are individually lighted

Rocking Again the Cradle of Flight

Pioneers Celebrate In Hammondsport the Days That Made Aviation History

By MILTON WRIGHT

FOR 365 days a year Hammondsport, New York, has a population of 1000 quiet-loving souls. Last Fourth of July, however, there were 50,000 persons in the village, all Hammondsporters at heart. It was the 20th anniversary of the flight of the famous *June Bug*.

Let us go back to the early days of aviation as the Hammondsporters did in retrospect. In 1907, Dr. Alexander Graham Bell, inventor of the telephone, organized the Aerial Experiment Association for the purpose of carrying on experiments with flying machines. Dr. Samuel Pierpont Langley had invented his machine which met with disaster on what was to be its maiden flight; and the Wright Brothers had flown their machine on the sands of Kitty Hawk, North Carolina. Aviation had been born, but its swaddling clothes had not been made. It had to be nursed carefully.

Dr. Bell was a close personal friend of Dr. Langley and he decided upon Hammondsport as the cradle within which to rock the infant industry of aviation. In the group invited to carry on research and experiment work was Glenn H. Curtiss, who, since 1903, had been the outstanding American

designer of light-weight gasoline engines. Curtiss had made several world records, most of them in connection with motorcycle racing. Since 1903, he had held the national motorcycle championship; in 1904, traveling more swiftly than any human being had ever traveled in any manner, he had established a world's speed record for ten miles which stood for ten years.

ALL of the dirigibles in the country were using Curtiss engines made in Hammondsport. This work had attracted the attention of the government and an order was placed for the first big dirigible balloon for the Signal Corps, thus marking the beginning of military interest in aeronautics in America. The balloon, driven by a four-cylinder Curtiss engine designed for the purpose, was built and tested in Hammondsport in 1905.

Because of his prior experience with engines and aeronautics, Curtiss was made director of experiments for the Aerial Experiment Association. Each member of the organization was to build and fly a machine after his own design.

On March 12, 1908, the first of a series of events took place which was



Underwood and Underwood

AFTER TWENTY YEARS

Augustus Post, old Aero Club representative, talks it over with Glenn H. Curtiss

to carry the name of Hammondsport around the world and write it indelibly in the history of aviation. On that date, Casey Baldwin, one of the members of the association, flew over the ice of Lake Keuka in his airplane, the *Red Wing*, designed by Lieutenant Selfridge, an observer for the United States Army and also a member of the organization.

On May 22, 1908, Curtiss flew the airplane *White Wing* a distance of 1017 feet in 19 seconds. This was achieved on the old Champlin Race Track. The *White Wing* was designed by Casey Baldwin.

ON July 4, 1908, Curtiss made his memorable flight of one mile in the *June Bug* of his own design to win the first leg of the SCIENTIFIC AMERICAN trophy. Of all the prizes he has won—and they are many—this is the one he values most highly. It marks the first pre-announced flight in America. This was the event whose anniversary was observed by the thousands of men and women interested in aviation who flocked to Hammondsport last July 4th to celebrate. Incidentally, this flight had exhausted the funds of the association.

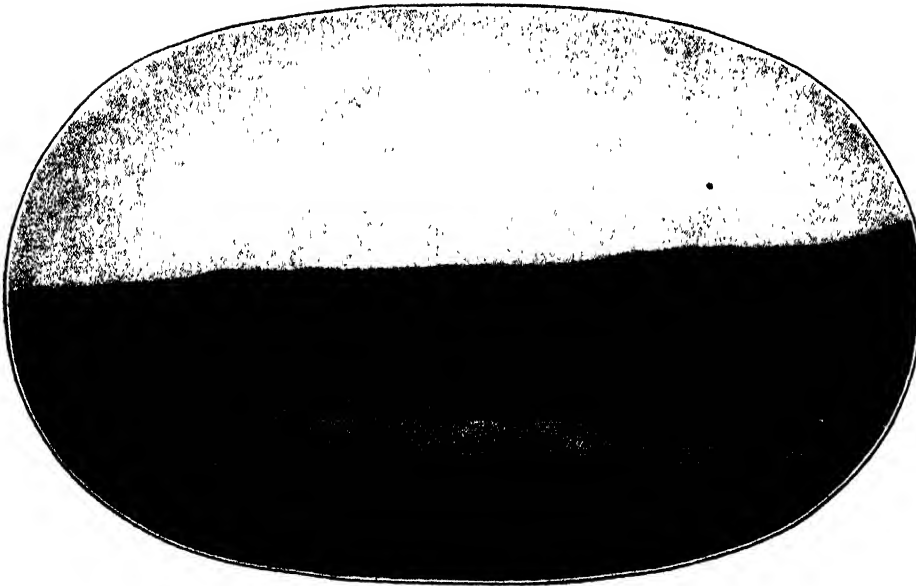
Curtiss and the village of Hammondsport, however, had just begun to make aviation history. On July 17 of the following year, Curtiss won the second leg of the SCIENTIFIC AMERICAN trophy, flying 19 times around a circular course for a distance of 24 7-10 miles, at Mineola.

On August 29 of the same year, Curtiss won the Gordon Bennett International airplane contest at Rheims, France, with a machine and motor designed and built at Hammondsport, bringing to America the first international aviation speed trophy.



A PIONEER MACHINE

This photograph, taken when the Aerial Experiment Association flourished, shows Curtiss at the wheel of the Silver Dart, a machine built at Hammondsport from motorcycle experience



THE FLYING FIELD TODAY

The Finger Lakes Association representing most of western New York has chosen this site for the new airport to commemorate the work of the men who developed aviation at Hammondsport

On May 31, 1910, Curtiss flew from Albany to New York, down the Hudson River, winning the third and final leg of the SCIENTIFIC AMERICAN trophy, as well as a prize of 10,000 dollars offered by the *New York World*. This flight, of course, was among the many discussed by the old timers as they gathered at Hammondsport. The manner in which the public looked upon Curtiss those days is illustrated by an anecdote which Augustus Post, one of the official observers of 20 years ago, related at the anniversary celebration.

"IN his flight from Albany to New York," he said, "Mr. Curtiss was allowed to make two stops; the first of these was planned to take place at Poughkeepsie and the second at the upper end of Manhattan Island. In searching for a suitable landing field at Poughkeepsie, he found a large, flat, beautiful lawn. He went to the proprietor of the institution owning the ground and asked permission to land there. 'Certainly, Mr. Curtiss, we shall be very glad to have you land,' said Dr. Taylor, head of the institution, 'this is the place where they all land.' It was the State Asylum for the Insane."

In the same year, Curtiss and his associates made the first flights to and from the deck of a battleship. In November of that year, the Secretary of the Navy sent naval officers to Curtiss at Hammondsport for instruction in flying. In 1909 and 1910, numerous experiments with Curtiss flying machines were conducted on Lake Keuka. On January 26, 1911, the first successful flight of a hydro-airplane was made. In July, 1912, the first air-flight boat was demonstrated on Lake Keuka. In May, 1913, flights of the first amphibian type of machine, de-

signed to start from and alight on either land or water were made. These amphibian machines were flown by Lieutenant B. L. Smith of the Marine Corps.

In April, 1914, the first tests of the twin-motored flying boat, *America*, were made. This was built for Rodman Wanamaker for a trans-atlantic flight test. It later developed into the famous NC type. The designation NC, by the way, stands for Navy-Curtiss machines.

In May, 1914, the famous Langley machine which had been wrecked in launching in 1903, was rehabilitated and brought to Hammondsport from the Smithsonian Institution. After its

restoration, it flew under the supervision of Dr. Charles D. Walcott, secretary of the Smithsonian Institution. Dr. A. P. Zahm, scientist, and Charles M. Manley, one of the Langley engineers, supervised the original construction of the machine. The successful flight at Hammondsport precipitated the famous controversy between the Smithsonian Institution and the followers of the Wright Brothers which only recently has been ironed out.

With such outstanding achievements to talk over—to say nothing of the many experiments with tetrahedral planes, helicopters, ornithopters and other types of machines, and the work done by army and navy officers who had their baptism in aviation at the Curtiss camps—there is little wonder that the old timers waxed enthusiastic.

A STATE airport should be established at Hammondsport, they declared, not only to commemorate the work done by the pioneers in the "Cradle of Aviation," but also because aviation needs an airport at that particular spot. Hammondsport, they pointed out, is in an ideal location for an airport. It is on a direct air route from New York to Buffalo, from New York to Toronto, from Boston to Cleveland, from Pittsburgh to Syracuse. In other words, it is a convenient location for a necessary stopping place between cities on the eastern seaboard and the middle west.

The route across Hammondsport, the old timers pointed out, presents far more satisfactory flying conditions than do routes over the state of Penn-



PILOT NUMBER ONE

When the Aero Club issued the first aviator's license in America seventeen years ago it went to the motorcycle speed king who had become a leading experimenter in airplane development

sylvania where the rugged mountains add to the dangers of flying. Then, too, they declared, there probably is no airport in the country as easy to find from the air as is Hammondsport, even in thick weather. It lies along the southern edge of Lake Keuka, a sheet of water 30 miles long. The lake is shaped like a giant Y and can be located readily, for no other lake looks just like it. In the wide valley planes are protected from dangerous blasts by high hills on either side. Then, too, if repairs or adjustments are needed, there are well-equipped plants at Hammondsport engaged in aeronautical manufacture. No community in the world is more air-minded than Hammondsport.

RECALLING the exploits of the past, the pioneers who labored together at Hammondsport began to plan for the future. Why not, they asked each other, revive the Aerial Experiment Association and carry on from where the old association left off? There are still problems in aviation to be solved. The solving of them may not bring money to anyone; they may bring a certain amount of glory, or they may not. But, at any rate, something ought to be done there. And who is better fitted for the task by tradition and by training than the men who received their education and their inspiration at Hammondsport?

There is no thought that the work which Glenn Curtiss and his associates began at Hammondsport has been discontinued utterly. The Army and Navy are doing constant research and development work for their own peculiar purposes. The company which Glenn Curtiss founded and which bears his name is doing wonder-



THE "JUNE BUG" IN THE AIR

By making the first pre-announced flight in the world of more than one kilometer in a heavier-than-air machine, Curtiss won the first leg of the SCIENTIFIC AMERICAN trophy, July 4, 1908

ful research work in its experimental laboratories at Garden City.

There, for example, is a great wind tunnel, the only one in the country owned by a commercial organization. When any new plane is designed, a small model, scaled down with perfect accuracy, is first made. It is placed and pivoted in the center of the tunnel in all sorts of positions and subjected to all sorts of conditions which the larger plane would experience. Weights and balances measure accurately the effect of all the conditions on the tiny model and the designers know exactly what to expect when the larger plane is completed and sent into the air.

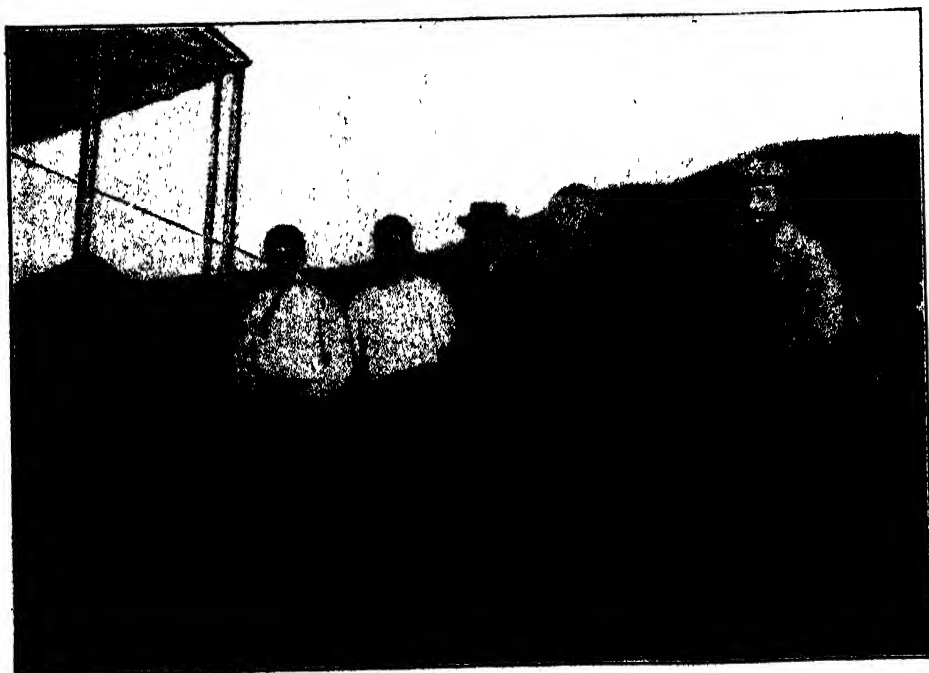
New motors are tried out, new materials originated, new shapes designed. The whole aerodynamic laboratory of

the Curtiss Aeroplane and Motor Company is founded upon the belief that aeronautics is destined to become an exact science, requiring the solution of many intricate problems, the highest type of engineering talent and the finest of scientific equipment. The facilities of the experimental plant include a testing laboratory for making structural tests of aircraft materials and parts; a chemical laboratory completely equipped for chemical investigations of aircraft materials, heat treating, and plating, and containing other equipment available for research on processes; and a fully equipped model shop, as well as complete manufacturing facilities for test production.

THESE things take vision—practical vision. But what of the fantastic dreams, of which nothing may ever come? Are they to be denied a place in the scheme of things? Great developments sometimes do eventuate from wild ideas. There are things to be attempted which the government and commercial organizations have no time to trifle with.

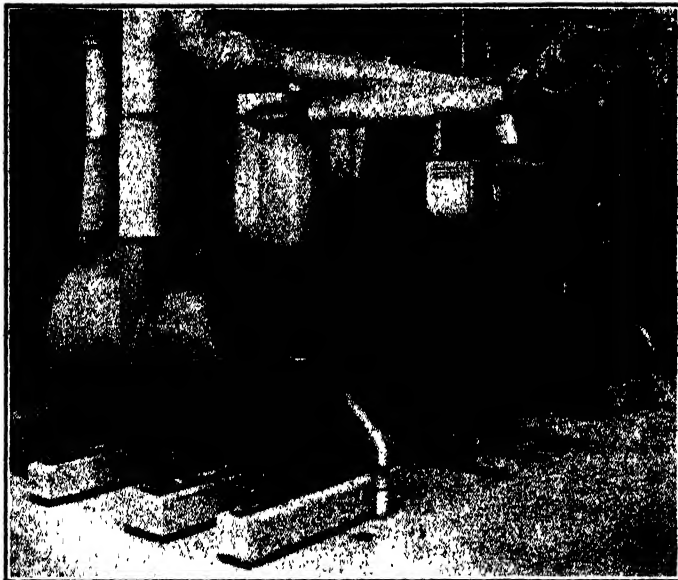
"We want to work with the 'pretty things' of aviation," said the old timers, "the radical things, the things that might be called visionary and impractical, but the things which may revolutionize the infant science of flying."

And how to accomplish this? How better, we might suggest, than by reviving the old Aerial Experiment Association, founded two decades ago by Dr. Alexander Graham Bell, the inventor of the telephone? Once more the infant industry could be rocked in the Cradle of Aviation. Hammondsport would not rest upon her laurels, but would send new wonders spinning through the clouds to amaze an earth-bound world.



THE MEN WHO ROCKED THE CRADLE

Casey Baldwin, Lieutenant Thomas Selfridge, Glenn H. Curtiss, Alexander Graham Bell and J. A. D. McCurdy of the Aerial Experiment Association, and A. H. Post of the Aero Club



A FIXED VACUUM SYSTEM CLEANS THE HOTEL

Dirt and litter are sometimes driven 1000 feet through the piping system to the dirt tank shown in the center between the vacuum units



A SECTION OF THE COFFEE SHOP KITCHEN

Each dining room has its own individual kitchen so that confusion of orders is eliminated. Banquet kitchens supply only banquets



FROZEN DESSERTS

Ice cream and frozen desserts are put in "cold storage" awaiting orders

In the World's Largest Hotel

THE STEVENS at Chicago is the largest hotel in the world. There are 3000 rooms and 3000 baths. A whole convention can be provided for. Last September one of our editors attended the Congress of the National Safety Council and every meeting, the exhibition and the banquet were all held in this vast hotel on the lake front. This year the same number of meetings will be distributed among three or four hotels in New York. It is the idea of concentration which dominates the Stevens. The hotel is very luxurious, but we illustrate only a few of the mechanical features. The vast ballroom holds 3000 diners who are admirably served by special kitchens. The hotel cost the enormous sum of 27,100,000 dollars or about the same as the U. S. battleship *Colorado*.



PRUNES

Thousands are being cooked at once and the syrup saved for sauces



THE SWITCHBOARD WOULD SERVE A TOWN OF 15,000

Immediately at the conclusion of a call a record of the charge is sent to the office by pneumatic tube. There are 348 trunk lines and 3300 inside lines for the use of guests and personnel



PNEUMATIC TUBE TERMINAL

This may be likened to a telephone switchboard. Only guests give verbal orders

Drafting Aids

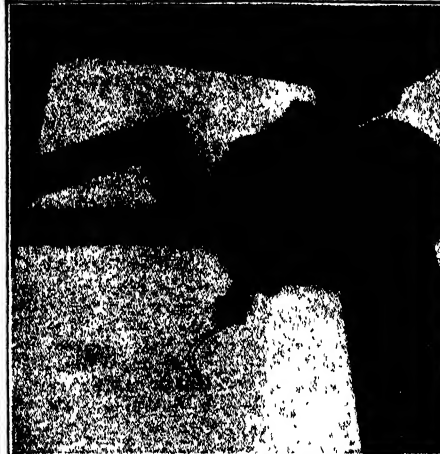
Tools Designed to Speed the Engineer's Work



Photographs Courtesy Eugene Dietzen Company

SWEDISH RULING PEN

Holds large supply of ink. Graduated thumb screw allows duplication of width of line



DOUBLE CURVE PEN

Useful in railroad work. Makes double line. Swivel joint allows universal "play"



LETTERING PENS

Built with adjustable nibs like ruling pens for holding much ink. For very heavy lines

THE complaint that drawing instruments are not up to pre-war standards seems no longer to hold true. Manufacturers, besides striving to keep up the quality, are also alert to the possibilities of new designs to save time, temper, fatigue, and guess-work. Illustrated on this page are a few able assistants to the draftsman.

With the Swedish pen shown in the upper left hand corner, any line width may be obtained by setting its graduated thumb screw; the setting can be remembered, and the line thus duplicated later. The photographs of the double line pen and the two lettering pens are self-explanatory.

In the center illustration, the upper pen has an extra nib, thus forming two ink reservoirs so that long lines may be drawn without refilling. The nibs of the center pen are adjusted by



RULING PENS

Top: Increased ink capacity due to third nib. Middle: Adjusts by turning milled top cap. Bottom: Nib turns so that it may be cleaned without disturbing setting

turning the milled cap on top of staff to raise or lower a wedge between the nibs. One blade of the lower pen swings out for cleaning without affecting adjustment.

The lettering device consists of a celluloid disk in a metal frame. Disk may be rotated and set by graduations on its edge, for horizontal spaces varying by $1/32$ of an inch. Upright guide lines at 68 or 75 degrees are drawn against its base while it rests on its side on the T-square.

The protractor-triangle is a two-in-one instrument. In the self-adjusting bow pen, the point is on a center shaft which remains stationary while the pen rotates freely around it. It is particularly efficient for drawing very small circles such as are necessary in the design of steel girders, et cetera, where rivets are shown.



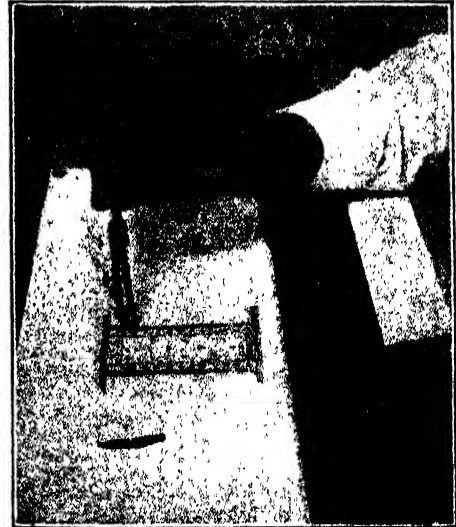
LETTERING DEVICE

For drawing horizontal and upright lettering guide lines. Text tells how it is to be used



PROTRACTOR TRIANGLE

The pencil points to the curved protractor scale. Line is drawn at the triangle's edge



SELF-ADJUSTING BOW PEN

Adapted to drawing of small circles. Needle on center rod remains stationary

Rendering Visible a Magnetic Field

An Account of the Accidental Discovery of a Peculiar Phenomenon Which May Later be Set to Practical Work. The Experiment May be Duplicated by Amateurs

By ELIHU THOMSON, Ph.D., Sc.D., LL.D.

Director of the Thomson Laboratory of the General Electric Company
Corresponding Editor, SCIENTIFIC AMERICAN

IT sometimes happens that a most inconspicuous phenomenon presents itself in the course of ordinary work which might easily pass unnoticed were it not for a habit of close observation acquired in laboratory practice. I propose to describe, in simple terms, an instance leading to the discovery of a "Novel Magneto-Optical Phenomenon," in 1921.

At the River Works plant of the General Electric Company, situated at Lynn, Massachusetts, a large building is devoted to the odds and ends of operations which enter into the construction of machinery, including such operations as the oxy-acetylene cutting of large plates of steel into various shapes, and the welding by oxy-acetylene blow-pipe and by electric arcs of parts of structures or machines to be finished in other parts of the Works.

THIS work was spread through the building, and here and there was to be found in operation an electric resistance welder using the Thomson process. In this latter form of welding very large currents are applied to the work without any arc, and the resistance of the work to these large currents provides the heating effect which enables parts to be heated, pressed to-

gether, and welded. Naturally, the operation of these resistance welders under very heavy current would produce in the space near them intense magnetic fields appearing when the current was on, and disappearing when the current was turned off.

Having thus briefly outlined the conditions of environment in the building, we may proceed with our story.

Early in April of 1921 it was noticed at the building which we have briefly described, that in operating an electric welder in which the very heavy welding currents were interrupted at intervals, a peculiar intermittent and widespread illumination of the space around was produced; faint indeed. The sunlight was coming into the room through windows back of the welder, and the direction of sunlight was on an angle downward from the sky above, corresponding to somewhere near the middle hours of the day.

I was called to observe this peculiar intermittent illumination of the space around the welder; a truly mysterious happening, such a thing as would be most unexpected. It was seen that the conditions existing were, as stated above, that the room illumination came in on an angle downwards from the sunlight entering the windows, and that a weak magnetic field extending from the welder came and went with each establishment of the welding current and its interruption.

This was a common enough condition in the use of electric machinery or apparatus, but whence the luminosity? A ghostly glow appeared through the surrounding air, manifestly

dependent on the existence of the magnetic field of the welding current following its fluctuations; but why was this present in this particular instance and not in others in which all conditions, so far as known, were similar?

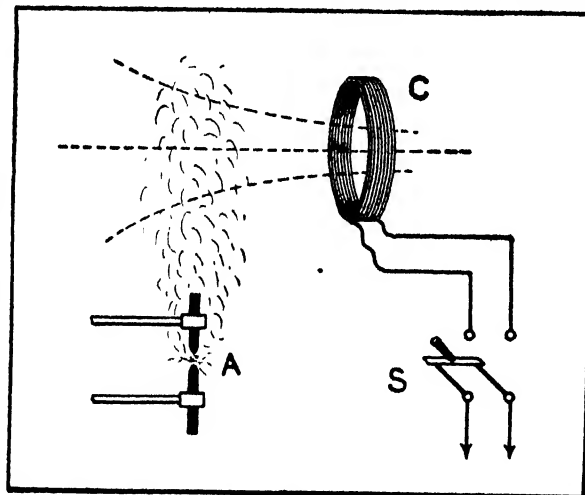


FIGURE 2

After confirming by careful observation that the appearances were real, although faint, I asked myself the question, "What is there about this building or the room in which the welding machine was operated that is different—what difference of environment, if any, exists from the ordinary surroundings?"

IN a large open space in the building, electric-arc welding with iron arcs was carried on at times, many feet away. It was conceivable that the smoke or fumes from the arc might diffuse themselves through all the spaces in the structure. So far as we knew, this was the only difference between the conditions here and elsewhere.

If our supposition that the luminous effects were due in some way to iron smoke was correct—and we took care thoroughly to ventilate the building—the curious luminosity should disappear. Actually this was found to be the case. It was then decided that the smoke of iron arcs, the minute particles

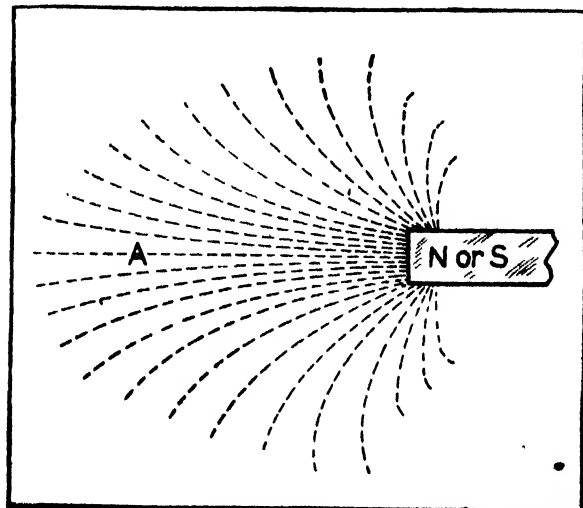


FIGURE 1

of oxidized iron or its vapor, floating imperceptibly in the air must constitute the difference for which we were looking.

Evidently then, the condition for observation of this new effect involved the presence of iron smoke, together with light falling on the smoke, and

in place or taking away the magnet pole "N or S," (Figure 1). The effect is then very marked.

It is well known that light reflected at certain angles from surfaces or particles suspended in a gas, such as air, will be found to be polarized, more or less, a test which is often resorted to

in order to discover the effects of sunlight in passing through the atmosphere or upon being reflected from surfaces, such as that of the sea, or even of the foliage of trees. It is natural, therefore, that early in our observations with the new effect of the luminosity, examination was made by a Nicol's prism (used to view the same in various directions). The light was found to be polarized as it should be, according to optical laws, when emanating from lines of particles, or strings of magnetized particles lined

up in a magnetic field. The effect which is absent when the coil "C" is cut off by opening the switch at "S." The effect is best seen when a fairly rapid opening and closing of the switch is made. The light in the field of the coil is then seen to flash or intermit in harmony with the switching movements.

If the direction of viewing be changed so that one looks along the axis of the coil or in the direction of the lines of force themselves, the effect is absent. The rotation of a Nicol's prism about its axis, through which one looks at the smoke in the magnetic field, shows at once that the light from the smoke is polarized, as before mentioned. This examination by the prism shows also that the smoke stream itself is composite. A bluish constituent of the smoke shows no polarization effect, while a yellowish-gray fume appears in viewing by the prism as extinguished or not, according to the position of the prism as rotated.

IN the course of our experiments we found that the iron smoke could be bottled up in a clear glass flask or bottle of, say, two liters capacity, and this receptacle when introduced into a magnetic field, and with a beam of light directed on it, will suffice to show the phenomenon, especially if the magnetic field is fluctuating, at which time there will be seen a flickering light in the flask or bottle corresponding to the variations of the field.

The particles suspended in the air of the flask are naturally heavier than air and will in time settle out, but it is astonishing indeed how slow this process of subsidence is; a fact which testifies to their extremely fine state of subdivision.

The coil "C" in Figure 3 is set up to produce a field by passing an interrupted or low-frequency current through it. The flask "F" containing iron arc smoke is held at different distances therefrom while illuminated by a light source from above. The flask has been held over an iron arc so as to receive the fumes and it is then corked.

that we should view it across the light into a somewhat darker background. There should also be a magnetic field, the lines of which crossed both the direction of the light and that of viewing. In other words, the line of sight should intersect both the light direction and the direction of the lines of the magnetic field present.

It might be supposed that the particles of iron or its oxide floating in the air were instantly lined up in much the same fashion as iron filings in a magnetic field, but in a more intangible and ephemeral sense. On the disappearance of the magnetism, they must fall into their original confusion at once and resume their helter-skelter suspension. The peculiar luminous effect would then cease.

THE accompanying Figure 1 exemplifies the simple conditions required to produce the novel effect as first observed. Let "N or S" be the north or south pole of a magnet giving a field of force shown by the thin lines emanating from the pole. Now if a beam of light comes down from above so as to illuminate the space in which the field lines exist, and we look across this field from a direction vertical to the paper, we see nothing unusual, but if iron smoke, even very dilute, as from an iron arc or spark, is present in the space "A" of the field, there is seen a luminosity not present before.

A better way of exhibiting the effect is to use, instead of the magnet, a coil of wire or an electromagnet, through which latter a current, either alternating or direct, can be intermittently sent by the opening and closing of a switch. This is equivalent to putting

up in a magnetic field.

One of the simplest ways of demonstrating the novel effect, and which is easily reproduced by anyone to whom ordinary electric current supply is available, is illustrated in Figure 2. "C" represents a coil of insulated wire which may be an open coil or which may surround a core of iron. Its purpose is to establish a magnetic field in the space around it, chiefly through its axis. Either direct or alternating current may be sent through it. A switch "S" is provided to cut off or put on the current.

AT "A" an arrangement for producing an iron arc exists, and this may be operated by either direct or alternating current. If the currents for the coil "C" and the arc at "A" are derived from a lighting circuit at ordinary voltage, care must be taken to have a sufficient resistance or impedance in the circuit with the coil and with the arc to prevent the flow of excessive current such as would blow fuses in the system of supply. It is not essential that an arc be maintained at "A." It suffices that interruptions between iron wires be made such that sparks are given from which iron fumes or smoke arise. Having arranged this apparatus before a window so that the light may enter the field from above, it will be seen that in the presence of the iron smoke floating upward in front of the coil "C," when the switch "S" is closed, the stream of smoke particles becomes apparently luminous, an ef-

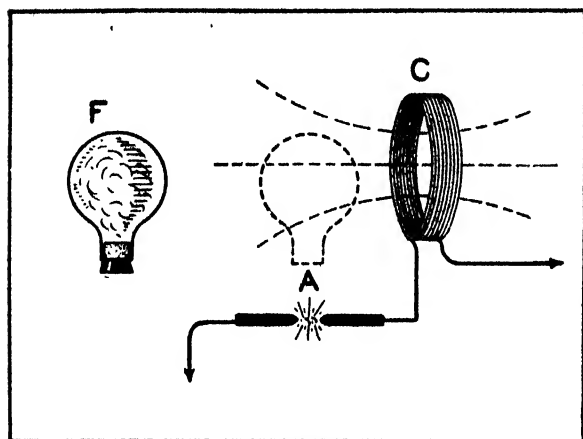


FIGURE 3

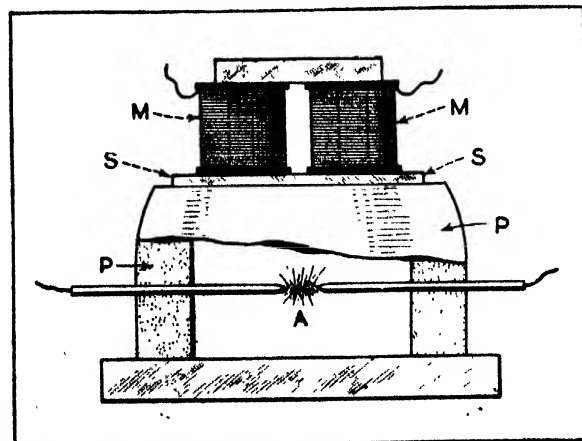


FIGURE 4

With a steady current in "C" the diffused luminosity in "F" is steady. With an interrupted current in "C" it flickers with the interruptions. With a low-frequency current in "C" (say

brownish powder without any visible arrangement or structure. If, however, the magnet "M, M" is excited by current when the fume or smoke is depositing on the slide, and such deposit

Since in electrical engineering we are constantly dealing with magnetic fields invisible to us, which fields are either established or extinguished by the passage of current or its being cut off, and since in certain forms of apparatus of very great importance indeed in electrical development we deal with magnetic fields which are moving or shifting or rotating, it becomes evident that any means for rendering visible such fields may at least be of much value in studying the actions and reactions in such apparatus as generators, motors and transformers.

It is also quite conceivable that even at relatively high frequencies of motion, when making use of stroboscopic methods, or, as it were, slowing up effects, one might employ the luminous magnetic field still more extensively. There has not as yet been any great amount of work done in this direction, but it may suffice to introduce here brief descriptions which are typical of the way in which the novel effect may be used.

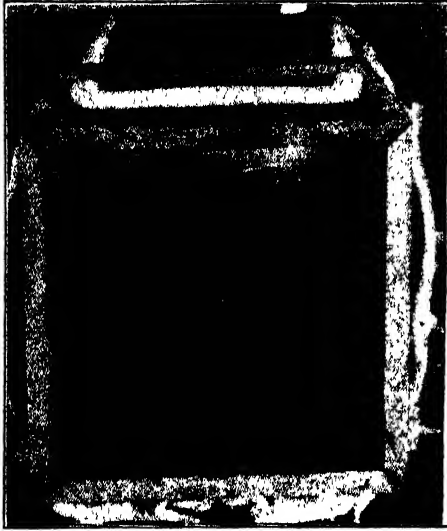


FIGURE 5

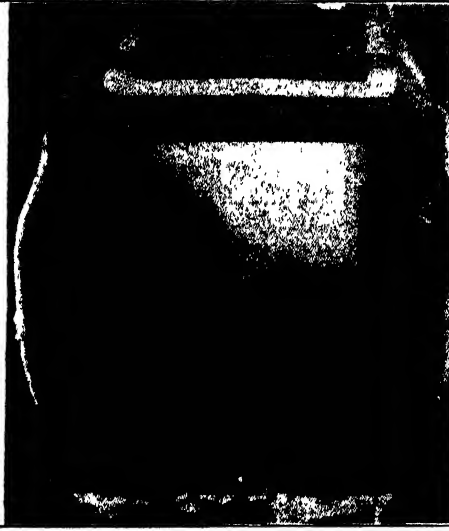


FIGURE 6

four to six cycles) the flask shows little flickering when near the coil, but this effect is more decided when the flask is removed further away. We have noted it even at a distance of 12 feet away from a coil seven inches in diameter and two inches thick in axial direction. The flickering keeps time with the alternations of current in the coil.

It is even possible to use the coil as an inductance and make and break its circuit at "A" while connected to a source of current, such as a 12-volt battery, or to the house current. This gives an arc or spark at "A" which with iron wire electrodes emits the smoke desired and which smoke can be caught in the flask by holding the open mouth over the spark gap in quiet air.

IN order to obtain some idea of the nature of the particles in the iron arc smoke, which, in a magnetic field are lined up or oriented so as to produce the luminous effect described, and the polarization of the light from the particles, an arrangement was made to receive the smoke upon a glass slide so that it could be examined by a microscope.

Figure 4 shows the arrangement used. "P, P" is a hollow cylinder of plaster of Paris for a support to the iron wire electrodes for forming an iron arc at "A." "S, S" is a glass microscope slide or other glass plate laid across the opening at the top of "P, P." "M, M" represent an electromagnet which can be energized by an electric current through its windings.

If the iron arc is drawn at "A" for a second or two, while the magnet "M, M" is without current (unmagnetized), the under side of the slide "S, S" receives a deposit of a light

brownish powder without any visible arrangement or structure. If, however, the magnet "M, M" is excited by current when the fume or smoke is depositing on the slide, and such deposit is examined, it is found to have a striated structure, the striations joining the positions of the poles of the magnet, as is the case with iron filings used similarly, although the particles in the smoke are exceedingly small, requiring high powers of the microscope to show them. They consist of strings of very small round globules of iron oxide, presumably ferric oxide, with an occasional group of much larger globules strung together in line and having at each end of the group fine-grained tufts of the oxide itself.

These larger particles strung together, usually by threes only, are evidently metallic iron. The slide itself behaves with polarized light as do the particles in the air, except that they are now immovable or fixed on the slide and retain their arrangement in striae or lines. The slide itself becomes, as it were, a polarizing structure for light. Between crossed Nicol's prisms the fine-grained tufts just mentioned become luminous on the dark field.

LET us refer here to Figures 5 and 6, which are photographs of a piece of apparatus for showing the novel effect. In both Figures 5 and 6, the same box with glass front and back for allowing light to pass through from back to front is seen surmounted by an open coil of insulated wire of rectangular shape. Iron smoke from an arc is allowed to enter the box from below. Figure 5 shows the photographic effect when no current traverses the coil, while Figure 6 clearly shows the luminosity produced within the box when a current in the coil gives rise to a magnetic field in the space within the box. Without doubt, such apparatus is susceptible of a considerable amount of development and improvement in its detail.

The apparatus shown in Figure 7 is indeed a simplified structure, involving the principles of three-phase current action whereby the rotating field produced can actually be rendered visible. Figure 7 is a photograph of this apparatus in its simple form.

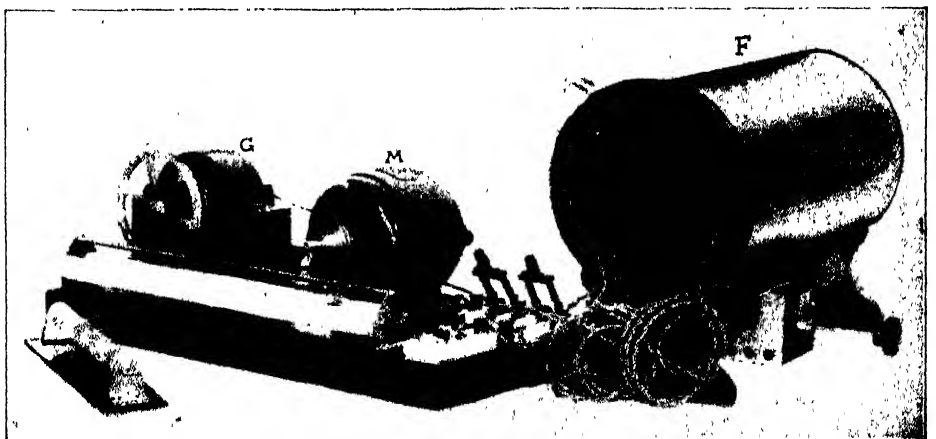


FIGURE 7

A motor "M" drives at slow speed a small generator, "G," of three-phase currents, which, through suitable switches and connections, are led to a cylinder "F" of insulating material such as wood, embodying on its exterior a winding, three-phase in character, whereby a rotating field may be produced within the cylinder. This latter is a free space with a glass plate back and front for confining the smoke from an iron arc, arrangements for producing which smoke are seen to the right extending under the body of the cylinder.

Suitably illuminated from the back when in operation, the apparatus permits the revolutions of the field within the cylinder to be seen clearly.

The apparatus allows the speed of rotation to be varied, and the direction of revolution reversed as desired by the simple manipulation of the switches provided. It is evident that in this way it is easy to arrange to show the effect of moving fields or distortions of magnetic fields by iron or by current-carrying coils in such fields.

THE principles above described may be, of course, varied widely, and apparently with no particular limit. Also, the scale of operations may be very small or they can be extended to cover large apparatus and large spaces; in fact, in the original observations which call attention to the presence of the phenomenon itself, it may be said that the experiments were made on quite a large scale, since the field of the welding coil involved extended many feet therefrom, while the illumination of the iron smoke was diffused through quite a large portion of the room. It could easily have been the case that if the scale of

operations had not been quite as large, the effect itself might easily have gone unnoticed.

There seems to be no consistent theory to account for the peculiar column of light seen in the western sky after sunset, particularly in the tropics, and known as the "Zodiacal light." If we assume, however, that the corona around the sun, always existing but seen only at the time of a total eclipse, extends in a diffused way without limit into the surrounding space, and is partly composed of or accompanied by fine particles, such as fine solids from condensation of vapors arising from the sun's atmosphere and perhaps propelled outward by the pressure of the intense solar radiation, we may form a hypothesis which seems to be consistent with our observations. As the spectrum lines of iron are prominent in solar light, it might be expected that in the space around the sun fine particles of iron would constitute, at least in part, those escaping streams from the sun, densest in the plane of the ecliptic. The earth would naturally be immersed in them.

If such particles could be of the same or of similar nature to the iron smoke particles, they might line up in space by the magnetic field of the earth when near enough to the earth. Then the Zodiacal light, seen best at places near the equator and at times of vernal and autumnal equinoxes, might be understood.

The broken lines in Figure 8 would represent, in a crude way, the magnetic field lines about the earth. Figure 9, being a view in the line of the axis of the earth, shows by dots the cut-across lines of magnetism in the equatorial plane.

Now assume that the sun's light, indicated by the arrows and broken lines. (Figure 9), comes up from below, and that in the direction of the magnetic lines, particles of iron (even ultra-microscopic) are lined up by the earth's magnetism in so far as to behave in the same way, but millions of times more feebly, as do the iron particles in our experiments. In this case, an observer at "A" on the night side of the earth looking outward to "C" and all the way up to "D" would perceive a faint lumi-

nous pillar of light in the sky. A glow would be seen in the sky even as late as 9 P.M. or later, and this would be repeated a few hours before dawn as if an observer was at "b" looking toward

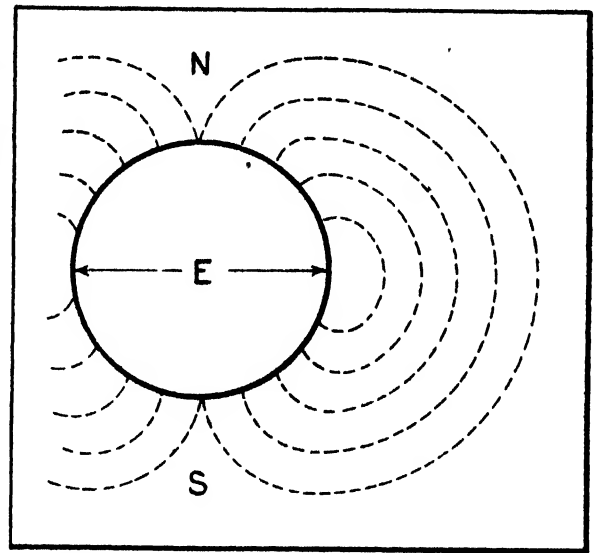


FIGURE 8

"e" and "f." The effect would extend outward from the earth as far only as the field was strong enough to orient the particles, and would, of course, depend also on the density of the particles themselves at various heights above the earth's surface, while they would naturally have a tendency to move toward the earth both by magnetic influence and gravitation. There has been no attempt to represent in Figure 9 any gradation in density. The angular altitude at which the light can be seen in the sky after sunset might give some idea of the extent upwards from the earth of the particles oriented by the field.

Examination by the polariscope should give similar results to those with the iron smoke, if the causes are the same.

Since the Zodiacal light must come from a great depth of space and its luminosity at best is low, an exceedingly small density of iron particles would suffice for producing the effect, a density perhaps very many millions of times less than the thinnest iron smoke ever present in the most feeble of the effects produced in our experiments.

The significant facts are that the direction of viewing is transverse to the direction of both the sun's beams and the lines of the magnetic field, in both cases. More and varied observations and experiments are certainly warranted in this fascinating field.

¶ To the scientist the evolving concept of the atom means simply that we are gradually learning. In an early issue Dr. Paul R. Heyl will endeavor to make clear to the layman just how the new wave-atom is to be thought of.

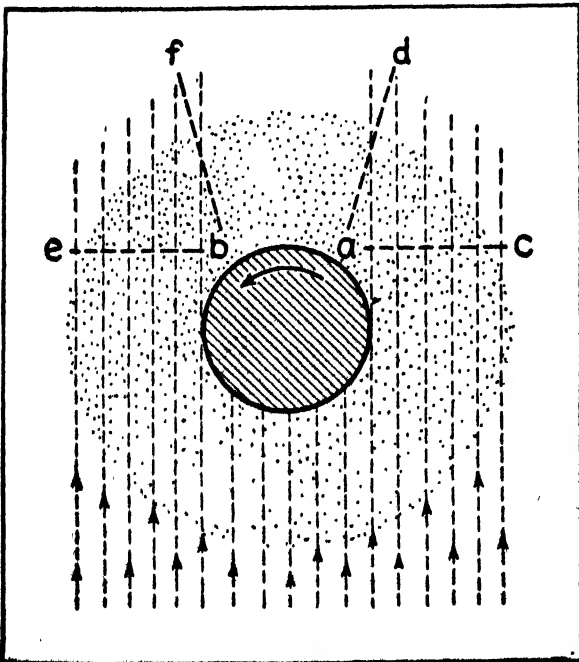


FIGURE 9

Three Years Aft the Mast

What the Non-magnetic Ship "Carnegie" Is Doing for Science On Her Three-Year Cruise

By JAMES STOKLEY
Science Service

BORN in Kansas, a graduate of one of the universities of his native state, which he never left until he was grown, never having seen the ocean until he was 24—surely one would not expect such a man to become the commander of one of the most peculiar vessels that ever sailed the seas, and to pilot it safely for 160,000 miles to all parts of the globe. But that description fits a man who has embarked on a voyage which will not be finished, according to present plans, until July, 1931.

Captain James P. Ault is the man—commander of the Carnegie Institution's non-magnetic ship *Carnegie*. Although he was born in 1881, only a touch of gray at his temples betrays the fact that he will be at the half-century mark when the present cruise of the *Carnegie* ends. For Captain Ault is the sort of man who remains perpetually youthful. He has made ready for the present cruise with as much enthusiasm as he probably displayed in 1905, when he made his first voyage on the United States Coast and

Geodetic Survey's ship *Bache*, from Norfolk to Panama.

This voyage was made in preparation for his later trips. At Baker University, in Baldwin, Kansas, he had acted as magnetic observer for the Coast Survey—watching the slight variations of a sensitive magnetic needle, to enable compasses to be used more accurately. Later in the same year as the *Bache* cruise—the year that he first saw the ocean—he sailed on the brigantine *Galilee*, which the Carnegie Institution had chartered, and which sailed for 73,000 miles, continually making observations of the variation of the earth's magnetism.

ALTHOUGH the *Galilee* was a wooden ship, it had a good deal of iron in its hull, iron and various pieces of magnetic hardware. As these introduced uncertainties in the measurements, the ship *Carnegie* was constructed with the wood held together with bronze nails and with bronze or other non-magnetic metals replacing iron and steel wherever possible. In

Why the "Carnegie" Cruises

ALTHOUGH the *Carnegie's* cruises are, in themselves, no longer news, so many misstatements concerning their scientific purpose have appeared from time to time in the newspapers that the editor publishes the accompanying article in order to set before the readers of the SCIENTIFIC AMERICAN an accurate, authentic account of the research in pure science which is being conducted by the scientific staff of the vessel. Mr. Stokley, the author, himself a scientist, enjoys the confidence of the seaman-scientist commander of the *Carnegie*, and he here points out plainly the purpose of the many kinds of observations to be made throughout the long cruise.

1914 when the *Carnegie* commenced her third voyage Captain Ault took command, and he has retained command on all subsequent voyages, with the exception of a short one in 1917.

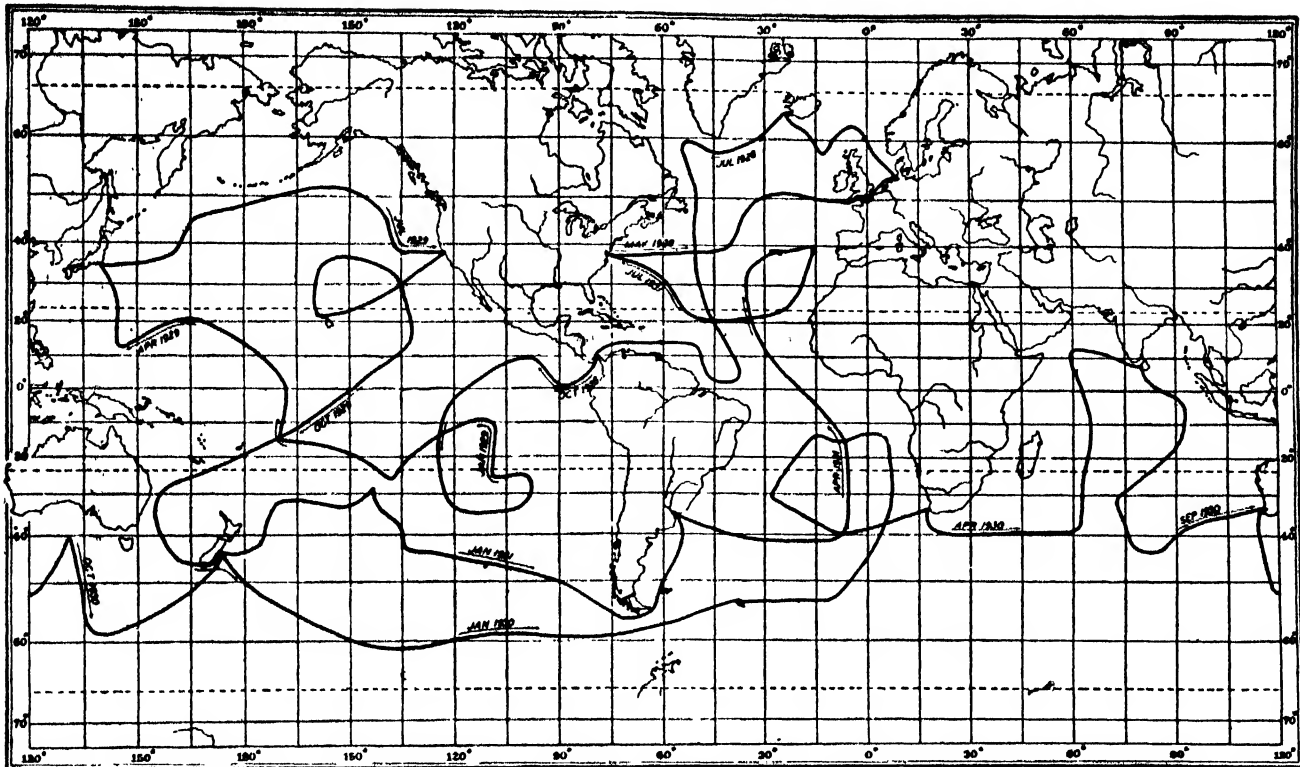
In his work Captain Ault is following the footsteps of Columbus, for it was Columbus who first noticed that there is such a thing as magnetic declination. Except in a few places on the earth, the compass does not point north. In the eastern part of the United States, it points to the west of the true north as measured by the stars. In the west, it points more to the northeast. The angle by which it deviates is called the magnetic declination. If you follow the compass needle to the place toward which it does point, you will find yourself north of Hudson's Bay, at the north magnetic pole, but with the geographic pole about 1000 miles farther north.

"COLUMBUS must certainly have been a resourceful leader and expert navigator," said Captain Ault before his departure on the *Carnegie*. "Do you know that the course he selected is exactly the same one that we would choose today in making the same voyage? Then, before he left the Canary Islands, he changed the rig of one of his ships from fore-and-aft to square rig. This shows that he knew he would sail in the region of the 'trades' with fair wind." When Captain Ault talks about sails, he speaks with authority, for the *Carnegie* is one of the few square-rigged ships still



THE NON-MAGNETIC SHIP "CARNEGIE," OF THE CARNEGIE INSTITUTION OF WASHINGTON

Strictly speaking, the *Carnegie* is not a "ship" but a brigantine, square rigged on the foremast and schooner rigged on the mainmast. This is considered the most comfortable rig in a seaway.



THE INTRICATE ROUTE OF THE "CARNEGIE" ON HER PROLONGED CRUISE

This and the equally circuitous routes of her previous cruises, cover the seven seas almost with a fine-toothed comb

afloat in these unromantic days of steam.

What is the use of such a voyage as the one now being made by Captain Ault? Such a question is often asked him.

"Well," he says in reply, "the oceans cover such a large part of the earth's surface that it is most important for us to know something of what is in them, and their physical condition. This is particularly true for some of the problems relating to the physics of the earth as a whole—what we call the science of geophysics. Our very life and environment and the evolutionary processes in the world are influenced in countless ways by the changing physical properties of the ocean.

"In the geophysical problems that we will study on our next cruise, those concerned with the earth's magnetism and electricity and with oceanography, much information has already been collected, but the work has really just gotten a start. The oceans are so vast that there is still plenty to be learned. We still know very little about the origin of the magnetism and electricity of the earth. We don't know how the two are related, and we are anxious to get more information as to their connection with such phenomena as the northern lights and radio transmission. Out at sea, away from the disturbances that often occur on land, we can make observations that will help us to greater knowledge of these things."

But magnetic and electrical observations are different from those made by the geographer, for example. When he goes into an unknown country, and accurately measures the contour of a mountain, it can be put on maps. Per-

haps a century later the maps may still be used, for, barring such catastrophes as earthquakes or volcanic eruptions, the mountain will then be substantially the same.

TO know about the earth's magnetism, however, requires continual observation. Columbus landed in 1492 at what is now called Watling's Island. But if he were to make the voyage today and follow the same compass-course it would take him to the island of St. Thomas, 660 miles to the southeast. In 1699 the great English astronomer, Edmund Halley, made one of the first ocean magnetic surveys on the *Paramour Pink*. Part of his voyage took him from the Cape Verde Islands to Rio de Janeiro. If he were to follow the same compass course today he would not get within a thousand miles of the same place.

One does not need to go even as far back as Columbus and Halley. In 1911 the *Carnegie* herself sailed from the Cape of Good Hope to Colombo, on the island of Ceylon. Today, the same compass-course would bring her to the mainland of India, 175 miles to the west, completely missing the island.

The result of this is that ocean-surveys must be repeated regularly, and it is on this account that the *Carnegie* will retrace much of her former routes. The information thus obtained will not only help in theoretical studies of the earth's interior, but it will have immediate practical results. The two cruises of the *Carnegie* in 1911 and 1920 in the Indian Ocean showed that in the central part the compass was changing as rapidly as a

third of a degree a year. Before the first of these voyages, this was not known, and so the charts for the region were more than five degrees in error. Such an error could easily mean hitting submerged rocks instead of passing safely through a channel between them.

"Side by side with the study of the earth's magnetism, we are studying the electrical field of the earth," says Captain Ault. "The importance of these investigations has increased in recent years because of the close relation between variations in atmospheric-electric and earth-current phenomena and variations in magnetic conditions. And the newest theories of the nature of electricity and the constitution of matter, as well as the great advance in radio communication, give added stimulus to the electrical studies. Because of the close connection between sunspots and solar activity in general with these effects we include the sun also, and last year we started to work in co-operation with the Mt. Wilson Observatory, of the Carnegie Institution, in these investigations.

"The electric elements which we are investigating include potential gradient, both positive and negative ionic content, conductivity and ionic mobility, penetrating radiation and radioactive content of the air. The potential, or electric charge, of the air increases with height above the earth's surface. At a height of a meter, it is about 100 volts. This is what we call the potential gradient. We measure it by raising a metal collector, installed at the stern of the boat, for a height of one meter, and noting the change in



Science Service

CAPTAIN AULT, IN COMMAND

He combines a rounded knowledge of science with a practical knowledge of navigation and seamanship, gained by experience

an electrometer connected to it. There are present at all times in the air the positively and negatively charged particles that we call ions. Ordinarily there are about a thousand of each kind in a cubic centimeter (about a sixteenth of a cubic inch) of air. With our instruments we can count these with fair accuracy.

"Closely connected with the number of ions in the air is its electrical conductivity, that is, its ability to carry a current. To measure this we force air past a charged conductor at a uniform rate of speed, and measure the rate at which it discharges.

"**A**NOTHER thing we want to find out concerns the penetrating or 'cosmic radiation' that Professor Millikan has been investigating in recent years. These rays are coming into the earth's atmosphere from outer space at all times, and we want to know whether or not they are one of the causes of the formation of ions in the air. We measure this at sea by determining the rate at which ions form in a closed vessel of copper. Then we also measure the amount of radioactive materials such as radium and thorium in the air, for these are another possible cause of ionization.

"On account of the electrical field of the earth, positive ions are continually traveling towards the earth, and negative ions upwards into the air. This gives rise to an actual electrical current between the air and the earth. It is sufficient to neutralize completely the charge of the earth itself in a very short time if there were nothing to renew it. Just what it is that renews it we do not know, although lightning has been suggested as a cause.

"Some of these measurements are rather tedious, as, for example, those of potential gradient. To determine this, observations must be made con-

tinually for a full 24 hours, with the apparatus at the stern of the boat. Sometimes the weather is bad, and so it is not at all comfortable, but we relieve each other for a few hours at a time. A complete run of such observations is made only once in two weeks, however. On our trip, this will be supplemented by a continuously recording electrometer attached to the top of one of the masts, far away from the salt spray which so often interrupts our other work.

"**F**ROM such observations as these we have learned some peculiar facts. This potential gradient reaches its maximum at the same time in all parts of the world. It comes at about 18 hours, Greenwich Mean Time, which is the same as 1:00 P.M., eastern standard time. It is at this time that the sun is overhead along the meridian of the north magnetic pole; that is, when it is noon to a person at the magnetic pole, or directly north or south of it. Here again we have evidence of a connection between the electrical and magnetic conditions of the earth, a connection which we want to understand more fully."

With the increasing importance of radio, and developments that have occurred even since the last voyage of the *Carnegie*, Captain Ault has planned to make observations specifically concerned with its problems. Also, the use of radio will add greatly to the comforts of the voyage, for the staff will continually be in a position to receive word from home, and even to listen to American broadcast stations. The transmitting equipment will not be very powerful, as it will have a range of only a few hundred miles. But this will permit communication with passing ships, and also enable instructions to be radioed ahead when approaching a port. Special signals will be sent out from various American and other stations, so that studies can be made of their reception. This will give greater

knowledge of the Kennelly-Heaviside layer, the strange conducting blanket that surrounds the earth and so affects



Courtesy the Carnegie Institution

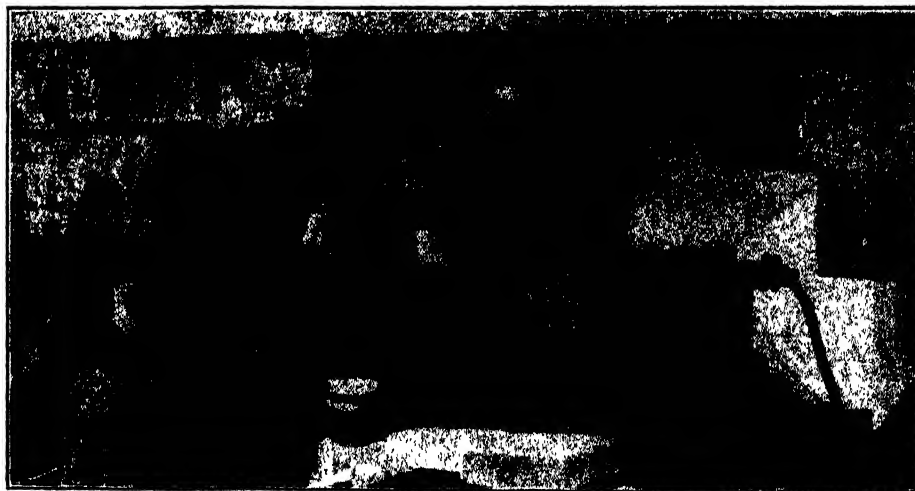
DUST DETERMINATION

The number of dust particles per cubic centimeter is counted as a daily routine matter

radio transmission, perhaps even making it possible.

Although the electrical and magnetic observations are more nearly related to the original purpose for which the *Carnegie* was intended, they will form only a part of the researches to be made on this trip. Study of the contour of the ocean bottom will be made by means of the sonic depth-finder. This is the first time that such a device has been used on the *Carnegie*, the Navy having loaned the apparatus.

The principle of the sonic depth-finder, which is rapidly replacing the old methods of throwing a line over-

**OSCILLATOR FOR SONIC DEPTH FINDER**

The illustration shows the keelson of the Carnegie, notched out for the part of the sonic depth finder which sends out the impulses which are reflected from the sea bed. See description in text

board, is that it takes a sound a certain time to travel, reach an obstruction and return to its starting place. In a mountainous country, one can sometimes estimate the distance of a cliff by measuring the time it takes for an echo to return, because the speed of sound in air is known. The speed of sound in water is also known, and it is sent out from the diaphragm of what is really a large telephone receiver. It



Science Service

AN OBSERVING DOME

Magnetic declination observations are made in a special glassed dome carried amidships

travels to the bottom of the ocean, is reflected, and then travels back to the ship. There it is picked up by microphones. The difference in time between the sound's leaving and return gives



Courtesy The Carnegie Institution

CAPTAIN AULT TESTING THE DIVING HELMET

A diving helmet of this simple type enables marine biologists to descend to small depths without delay and without the hampering bulk of the professional diver's expensive accoutrements

a measure of the depth of the water.

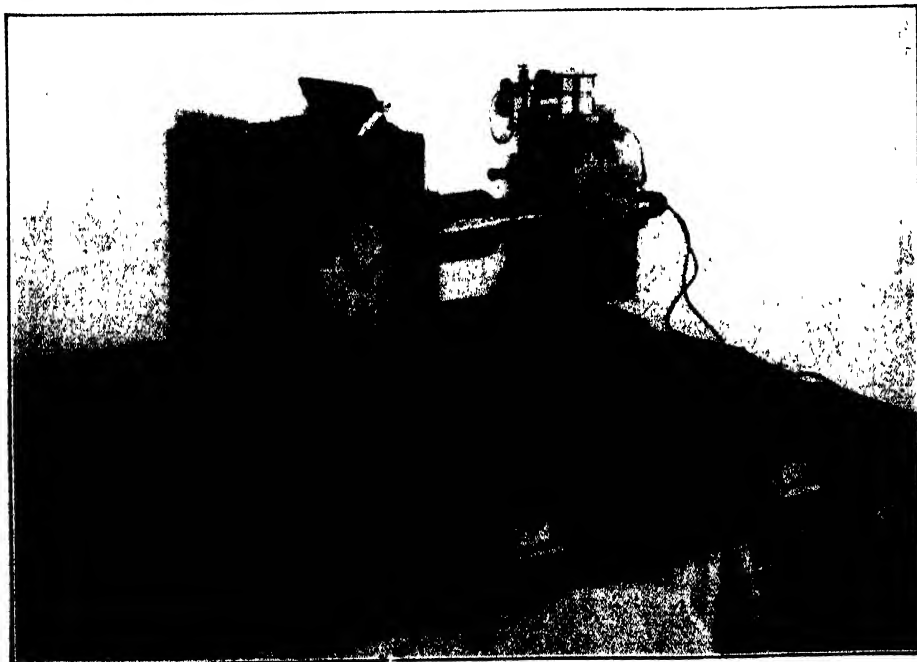
To study the composition and temperature of the water at various depths, the ship will heave to every other day, and special water-bottles will be lowered. Thus samples of the water and its contents will be obtained at depths down to as far as 20,000 feet. To handle these water-bottles a new electrically operated winch has been installed on the deck, with the drums made of bronze, so as not to interfere with the magnetic work. A special aluminum bronze cable that in addition to its non-magnetic properties pos-

sesses extreme strength as well as lightness, has been imported from Germany for this use. This winch will also be of use to the sailors of the ship in handling the sails.

FOR the first time marine biology will form an important part of the Carnegie's work. Specimens of the tiny organisms obtained by the deep soundings will be studied and in addition a pump will continually force water through a sieve to collect interesting specimens. The biologist of the party, if he wishes, will even be able to study the marine life at first hand, at least in shallow water, for a diving helmet capable of use down to 100 feet depth is now part of the equipment.

The last but not the least important part of the Carnegie's work will be the study of ocean weather conditions. Admiral Maury, an American naval officer, started the study of ocean meteorology, and his book, "Physical Geography of the Sea," is still a classic. Captain Ault and his associates intend to continue this work with observations of the usual kind, as well as of variations in solar radiation, the importance of which in meteorology has only in recent years been recognized.

The staff of the ship includes seven scientists and 17 seamen. This is larger than before, because of the additional work that is to be undertaken. Not until July, 1931, will they again sail up the Potomac, if all goes well. And with all the preparations that have been made, it seems certain that all will go well, and that the return will mark a great increase in scientific knowledge.



THE ATMOSPHERIC ELECTRIC POTENTIAL GRADIENT RECORDER

This instrument, in a box attached to the top of the Carnegie's mast, away from effects of spray, will make a continual record of the variations of the electric potential gradient of the atmosphere



A HERD OF GUERNSEYS, NOTABLE FOR ECONOMIC PRODUCTION OF BUTTERFAT AND HIGH QUALITY MILK

The Economics of Dirt Farming

By FRANK BYERS

MODERN Efficiency Methods. What a vast amount of attention this subject has had in recent years. It is right that it should have. Man began to emerge from barbarism when he started to find better ways of doing things.

When modern methods are applied to agriculture, problems are met which are much more complicated than the problems of industry. Just what and why these problems are can be understood by the construction engineer or the builder who must work exposed to the weather.

AMERICAN industry has achieved its success by efficiency on these points:

1. Improved machinery.
2. Maximum power per worker.
3. Large production per man.
4. Large volume.
5. Standardized product.

The success of these efficiency points is more easily attained and can be more unlimited in industry than in agriculture. For example: consider the building of a tractor and the use of that tractor by a farmer. In the building of

Aid For the Farmer!

JUST as surely as day follows night, farm-aid bills frequently appear before Congress and are discussed pro and con. The reports of the progress of these bills often are featured in the daily press, but the average reader knows little of the conditions which make aid a serious economical consideration.

The author of the article which we present on these pages is an experienced farm manager, and we believe that our readers will agree with us that he presents the economics of the farm in a most comprehensive manner, and throws a revealing light on the difficulties which beset the agriculturist.—*The Editor.*

the tractor it is possible to use a solid floor for men and machines to stand on; a roof to keep out the rain; proper light and heat. Let sales create the demand and if necessary the tractor plant can run 24 hours a day in all kinds of weather, and every day in the year.

Take one of these tractors out on the farm. It can be run 24 hours a day, but not if it is muddy. A tractor might

run in considerable mud, but no farmer would want to work his soil when wet, because a proper seed bed must be prepared with a dry soil.

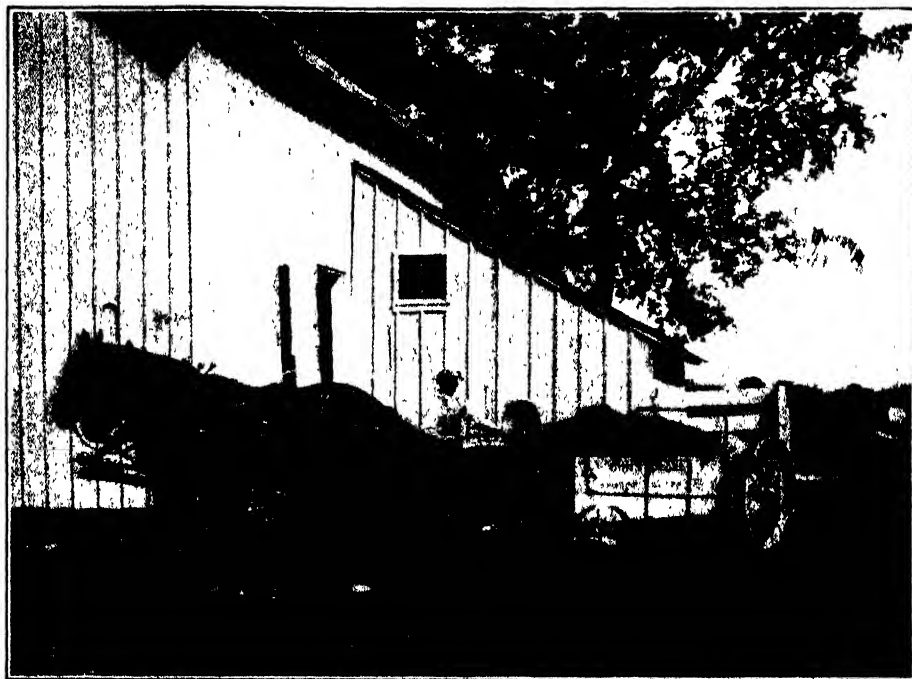
In industry, machines are applied to steel, wood, and similar materials, which do not materially change their physical condition every time it rains. Soil is not only composed of the elements of plant food, but also is the home of a host of living bacteria, friends of the farmer. These organisms must be treated with respect. They must have air to multiply and carry on their numerous enterprises. Decomposing organic matter, securing nitrogen from the air in the case of leguminous plants, rendering the elements of the soil available to the tiny plant roots in a soluble form—this is the work of the various soil bacteria. To cultivate the soil when too wet, means the death of these necessary bacteria, for unless the soil is worked when dry, it packs and bakes into a hard air-excluding mass.

THEREFORE, a farmer could be equipped with the latest and most efficient power machinery, but he could not use it until the soil conditions were right, and if a season should be

one of continuous rain, he could do nothing. While the farmer waited for it to quit raining, the manufacturer of tractors could be busy every day, utilizing his power machinery and labor to build more tractors, increasing his output per man and decreasing his cost per unit.

This comparison also brings out another point, which is this, that economically a farmer gains nothing by saving time, if he cannot use that time on some productive work. The element of time is very important in some farm operations. The planting of corn and other crops, the harvesting of leguminous hays and grain, all need to be rushed to completion to avoid loss, and in these operations, modern farm machinery has effected its greatest economy.

THE United States Department of Agriculture reports that since 1889, the efficiency of the agricultural worker has increased more rapidly than the efficiency of the factory worker. There are exceptional examples of efficiency in industry, where inventions and machines have greatly increased the output per worker. These outstanding successes have been chiefly where iron and steel are fabricated. Industry cannot claim any great efficiency in the building trades, for here, as in agriculture, machines are difficult to apply and much hand labor is necessary. In crop production, it is difficult to have set rules of procedure. Suppose that we are in the midst of our first alfalfa hay harvest. Just when is alfalfa properly cured and ready to be put in the barn? Shall we cut today, rake tomorrow and haul in the third or fourth day? That will depend upon the rankness of growth, the moisture in the air and soil, the brightness of the sun and the presence of wind. All of



A SAVER OF MAN POWER

This manure spreader automatically unloads by horse power, saves the man power formerly required for unloading, and distributes the manure evenly over the soil, insuring better crops

these things influence rapidity of drying, and all of these influences vary in degree in June, July, and August, in which months our three crops of alfalfa are harvested. Alfalfa is cured when it is cured, and the farmer knows when it is cured by lifting it and by feeling and looking at it.

Farm cost accounting cannot be standardized in every case. For example, the crediting of manure produced by live stock to that live stock and the charging of the manure to the crop upon which it is applied requires the consideration of these questions. First, different crops respond to manure and are benefited by it in different degrees. Second, the fertilizing value

of manure is not all taken up by the crop the first year, and succeeding crops on that land receive some benefit for several years. Considering these points, what value is to be placed on a ton of manure and what percent of the charge should be against the first year's crop? If manure is applied to the land and the crop is a failure, can the livestock be given any credit?

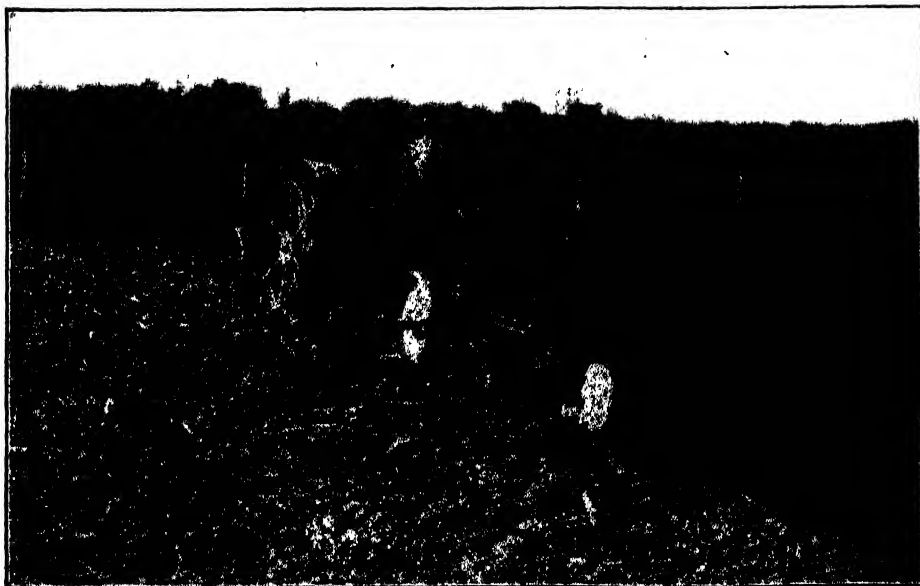
Increased efficiency pays the individual farmer well. The total cost of growing an acre of corn remains fairly constant regardless of the yield. It costs the same to grow an acre of poor corn as an acre of good corn. Therefore yield per acre is important, as an influence over profit and cost per bushel.

THE large tractor plow has been the means of reducing labor costs on field work. In this implement, one man has at his command 20 to 40 horsepower. The saving in labor that can be made by larger plows is shown below.

One Man Using Different Sized Plows

Number of Bottoms	Power Used	Acres Plowed	Total Cost per acre	Labor Cost per acre
One	Two horses	2 1/4	\$3.20	\$1.78
Two	Five horses	Five	2.38	.80
Three	Tractor	Nine	1.62	.44

In industry there is 4.5 mechanical horsepower used per worker, while in agriculture, there is about three horsepower per worker. However, in the use of mechanical horsepower, the farmer is at a great disadvantage, for the simple reason that during the



A MODERN POWER PLOWING OUTFIT

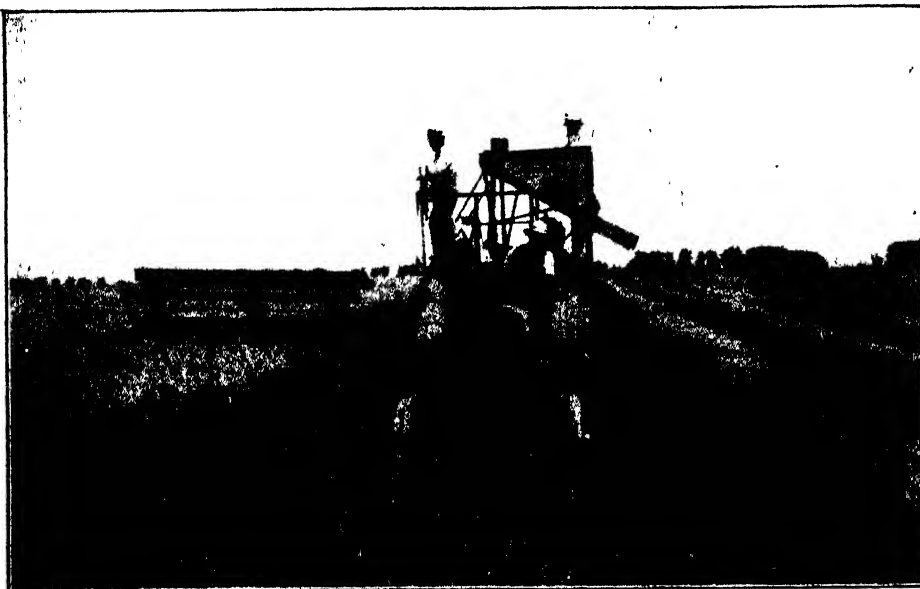
This type of plow will work from 10 to 15 acres per day, depending on soil conditions, and thus will do the work of two or three men and from nine to 15 horses, reducing labor costs materially

winter months his shop is closed and he cannot use his power. The result is that the farmer's use of mechanical horsepower per average month is very low.

The difficulty of continuous productive operation is a great barrier to farm efficiency. It is hard to keep machines, horses and tractors busy, for

AGRICULTURAL MACHINES

1. Movable.
2. Exposed to Weather.
3. Insecure Footing.
4. Material Irregular.
5. Conditions Varied.
6. Minimum Hours Used.
7. Area Extensive.
8. Supervision Difficult.
9. Piece Work Impossible.



A COMBINED CUTTING AND THRESHING MACHINE

This machine will cut and thresh from 20 to 60 acres of grain a day, depending on size. Two men can operate it, and it is said to be the greatest labor saving machine yet given to agriculture. Twenty men are needed to operate a machine which accomplishes threshing only

when one piece of work is completed, another must be started. Growing a bushel of corn calls for many different operations: plowing, disking, harrowing, planting, cultivating, harvesting with corn binder or corn picker, and finally storing or marketing. For each of these operations a different machine is used, with horses or tractor as the power. Most farm machines are used only a few days each year and since one of the rules of shop practice is "more hours used means greater efficiency" a difficult problem is ever present. The efficiency and durability of the tractor is nearing perfection. On field work it is greatly reducing labor costs, but for drawing loads, its usefulness is limited by mud and rough frozen ground, and also by available farm work of this kind to be done.

SOME of the ways in which agricultural machines differ from industrial machines in actual operation are listed as follows:

INDUSTRIAL MACHINES

1. Stationary.
2. Under Cover.
3. On Solid Foundation.
4. Material Uniform.
5. Conditions Uniform.
6. Maximum Hours Used.
7. Area Limited.
8. Supervision Easy.
9. Piece Work Possible.

Farm cost studies show that as a rule production is more economical on large farms than small. However, there is a limit to how large the farm can be. The farming of very large farms as a unit has been only partially successful, especially in the middle west. There have been some very successful large wheat farms in the northwest, but since the one-crop farm is economically and scientifically unsound, these successes must be rather temporary.

LARGE, level fields are best adapted to large power machines. It is not always possible to find hundreds or thousands of acres that are level and unbroken by hills and swamps. If the large power unit can start out in the morning and run all day it accomplishes much, but if the work is to be done in a distant field, then much time is lost going there and back.

If the large farm is divided into smaller units then we are back to the small farm again, but with some added efficiency through better management.

Farm tractors and machinery travel very slowly, although in recent years implement manufacturers have greatly increased the speed of tractors moving idle. Small fields require much turning, and turns must be made with the machine idle.

It would be possible to farm efficiently a very large level acreage,

considering only the preparation and planting of crops. The growing of large and profitable crops, however, brings us into the questions of soil fertility and crop rotation. The soil is not an inexhaustible bank from which yearly supplies of plant food may be drawn, without an accounting sooner or later, and it is usually sooner. At an Illinois station, which has the oldest experimental plots in the United States, where corn has been grown continuously for 50 years on the same ground without soil treatment, the yield is less than 25 bushels per acre, while corn grown with soil treatment in a rotation of corn, oats, and legumes has yielded 70 bushels per acre.

A three or four-year rotation has some advantage in that it distributes the labor over the season. It also requires that the acreage be divided into the three or more parts according to the rotation. To divide the land into smaller parts, each with its different crop, requiring to considerable extent different methods and machines, is contrary to modern factory procedure, which aims to combine and unify, rather than to divide and vary.

THE application of manure, while not absolutely necessary, is highly desirable, and this requires the keeping of livestock which has its complications in labor, buildings, reproduction, and last, but most important, market selling price. It is very easy to feed all the crops from a farm into livestock and lose any profit that might have been secured by selling the crops. This, of course, depends upon the relative market value of crops and livestock and also upon the farmer's cost of growing those crops, but it is impossible for even efficient crop production to cover up the loss sustained by a low price for the final livestock product. Industry figures its costs and decides what the selling price of the finished product should be. The farmer can figure his costs of production, but he cannot establish his selling price. The selling price of most farm products is named by the buyer.

"The eye of the master fatteneth his cattle," is just as true now as it was when written, and in milk production, beef production, and all other livestock enterprises, there is an element of love of work which is essential to success. To carry out the latest and best methods of feeding and care may not be enough. Every employer knows that personal interest cannot always be bought. In reproduction and inheritance we have elements of chance and variation, which are absent from industry.

It would be possible to operate efficiently a large grain farm of a thousand acres or more without the use of livestock. Such a farm should be all level land to provide large fields for the

operation of large power units. The fertility of this farm could be maintained by plowing under legumes, and applying the proper fertilizer. The individual small farmer cannot afford to own some of the large labor-saving machines, because he cannot use them enough, but the large farm could afford to own them.

The large grain farm presents difficulties, viz:—continuous use of labor, efficient labor, maintenance of fertility, and advantageous marketing, but it does offer great opportunity for the efficient use of labor-saving machines.

The manufacturer given his efficient machine can turn out a perfect product. To increase the volume of his product, he needs only to operate more of his efficient machines. How different it is in agriculture.

Consider the humble cow; without her milk, your children and mine would be small, just as are the Japanese. The dairyman may have one cow in his herd that is a very efficient and profitable milk-producing machine. According to the laws of heredity, the heifer calf from this cow should grow to be an efficient milk producer, as was her mother. But alas, this proves true only about 50 percent of the time. This calf when mature, may not give enough milk to pay for the feed alone.

THE breeder can influence and aim toward perfection, but the blood of every individual carries the characteristics of a thousand ancestors good and bad, which may crop up in offspring.

Since milk production is built on maternity, a 100 percent crop of bull calves is a fly in the ointment. It takes from two to two and a half years for our promising heifer calf to grow into maturity and start producing milk and until then, the value of this animal is an unknown quantity, so far as economical milk production is concerned. The cow does not give milk until she has a calf, as most readers know on second thought.

Where in industry is the machine, the economic value of which is not proved until two years after the machine is created? There are none outside the experimental rooms, or should not be. The cow which proves to be unprofitable as a producer of milk, is sold for beef, and returns about one third the cost of raising; the balance is a loss.

The milking machine is being perfected. It has been on the way for some 20 years. Why has it taken this long? Simply because in the milking machine, we have the application of a machine to a live animal. What machine in industry requires the co-operation of a dumb animal for successful operation? A cow is not a cow when a milking machine is put on her. Cows are just as different in disposition

as humans, and one bossy will give down her milk freely to the machine, while her stall mate may refuse to let down a drop. However, the milking machine is making progress as a labor saver. On one farm managed by the writer, the hours spent daily on the dairy herd was reduced by four with the installation of a milking machine.

LARGE volume, which is an efficiency factor in industry, meets with a stumbling block in nearly all livestock enterprises in various diseases, which seem to cause greater losses in large herds than where only a few animals are kept. The crowding of livestock encourages the spread of disease. Where large numbers of livestock are desired it is advisable to divide into small units. Hogs and poultry become diseased in old yards, and it is necessary to move to fresh clean ground.

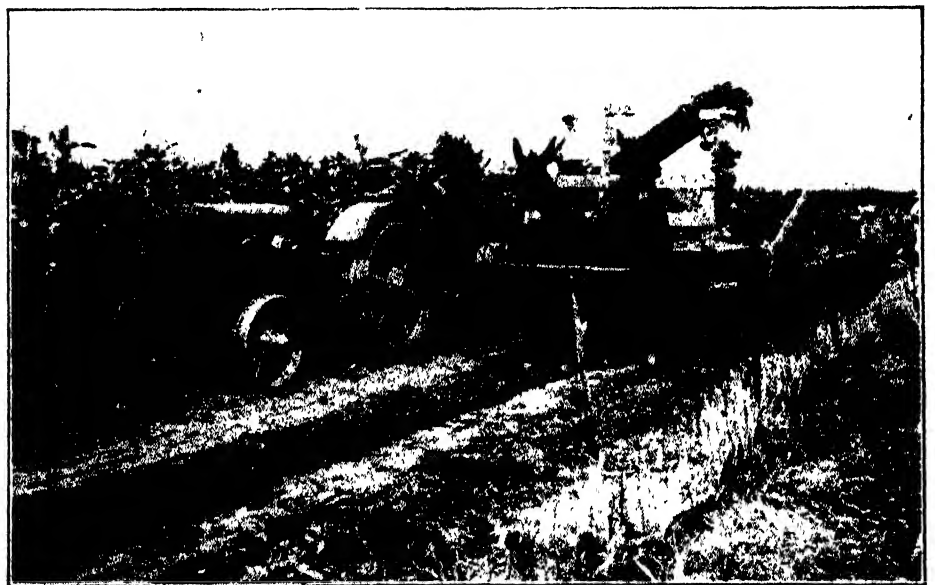
In industry, quantity production is the method by which raw materials can be transformed into salable goods in the least possible time. The shorter the time, the lower the costs. Continuous operation and movement makes this possible. But in agriculture, the transformation of plant food into finished crops is a process requiring months of time and in most cases there is but one turnover in 12 months. In pork production, there can be two crops of finished pigs per year, and in

The one-horse hillside farm, which will probably always be with us as a losing business enterprise, is largely responsible for the disastrous surplus. These small infertile tracts are not adaptable to power or large scale production, yet upon them some farmer is content to scratch out a meager existence. To this class could be added some ill-advised swamp reclamation projects and millions of acres that would be more profitable if timber were grown on them.

FARMING is a business in which the many problems must fall upon the shoulders of one man. The farmer must have knowledge of crop production, livestock, buying, selling, and all their related sciences. He must be his own carpenter, machinist, gas engine expert, plumber, electrician and book-keeper. Specialization, which has been such an aid to industrial efficiency, is difficult to accomplish on the farm.

The farmer can improve himself, his farm and his financial condition by the study and application of the following subjects:

1. Farm Cost Accounting.
2. Soil Fertility.
3. Soil Drainage.
4. Improved Seeds.
5. Improved Live Stock.
6. Better Marketing.
7. Sanitation.



CUTTING AND BINDING CORN

The corn binder cuts, elevates the corn to the wagon, and binds it

beef production, one in 12 to 24 months.

That increased efficiency will pay the individual farmer well is very evident from the results obtained in farm cost accounting work, carried on by the Agricultural Experiment Stations. That a general increase in efficiency on all the farms of the country would result in a greater surplus and call for improvement in merchandising methods is also true.

8. Scientific Feeding.
9. Labor Saving Machinery.
10. Better Homes.

That the farmer can and will become more efficient, there is no doubt, but until a way is found to control the weather, the farmer will always take that risk in his work. Improved machines and methods will accomplish wonders in future years.



Fairchild Aerial Surveys, Inc.

THE SCENE OF THE ACTION

The approach is laid, the shore abutments in place, the western pier finished—all waiting for a little gang of workmen doing some mysterious job in the middle of the Hudson River. When they finish they will have left behind them a monument to ingenuity and patience

The Caisson Slipped

Righting a Bridge Pillar Foundation Is One of the Hardest Tasks Engineers Ever Attempted—and Accomplished

By LLOYD LLEWELLYN

IMAGINE a building 60 feet wide, 136 feet deep, and eight stories high. Conceive of this building not as composed of a lot of rooms but as a solid block of concrete weighing about 16,000 tons. Picture it sunk deep in mud and tipping over at an angle of 45 degrees. Now, to make it still more complicated, suppose that the whole building, except one tiny corner of the roof, is submerged under a deep, fast-moving river.

Imagine that it is your task to pull that ponderous structure, having an under-water weight of 12,000 tons, back to the perpendicular.

Such is the job in the Hudson River at Poughkeepsie upon which engineers have been working since July, 1927. It constitutes one of the most difficult feats of corrective work known to the history of engineering. Compared to it, righting the Tower of Pisa would seem like child's play, for all of the work in the Hudson must be done by divers, much of the time in water so muddy that they cannot see what they are doing but must feel their way.

At Poughkeepsie, just south of the famous structure which is said to be the second highest railroad bridge in the world, the State of New York is preparing to throw across the river a

mighty span over which vehicles and pedestrians may travel from one shore to the other. When completed it will be known as the Mid-Hudson Bridge. The original estimated cost of the completed structure was 5,500,000 dollars, a cost which probably will be exceeded by several hundred thousand dollars. Originally it was intended that the bridge would be open for traffic by January 1, 1929, a date which already has been postponed a year.

THE engineers in charge of this work are Modjeski and Moran, reporting to Colonel Frederick S. Greene, Superintendent of Public Works for the State of New York, with Clarence W. Hanson in direct charge on the job for Modjeski and Moran. Mr. James M. Bixby, Division Engineer, and L. S. Hurlburt represent Colonel Greene on the work. The contractor is the Blakeslee Rollins Corporation of Boston, Massachusetts, and is represented by J. W. Rollins, vice president, and Ray J. Reigeluth, while Walter G. Cheever is the superintendent in direct charge on the work. Nearly half of Cheever's 35 years have been spent with this one company doing engineering jobs which would have made Cheops or Hiram Abif gasp

with incredulity at their difficulty.

Nothing is more important in a suspension bridge than the pillars whose bases rest far below the bed of the river and from whose tops, towering high in the air, are swung the steel cables from which the causeway is hung.

Work on the two caissons began April 1, 1927, and for some time proceeded uneventfully. Each of these caissons was a huge steel shell 136 feet long and 60 feet wide, with the ends rounded, making it a sort of huge steel scow. Technically each huge steel rim was called a cutting edge. Concrete walls divided it into cells or sections, each one of which had a false bottom so that the entire steel shell formed a wall or hull which was towed easily from the yards at Staten Island, where it was made, up the river to Poughkeepsie.

At Poughkeepsie concrete was poured into each of the 25 pockets in each caisson until it was almost heavy enough for sinking into position; then it was towed to its proper place in the river and anchored broadside to the shore. More concrete was poured into each of the sections, the added weight causing the caisson to sink. Wooden forms were built up on top of the

caisson to a height of about 20 feet. More concrete was poured in, the caisson sinking deeper and deeper down through the bottom of the river, so that eventually it would rest on hardpan or rock.

The river bottom is uneven. Little difficulty was presented in the sinking of the western caisson where the water is 60 feet deep, with a layer of sand and mud about 35 feet below that and hard rock below the mud. All the work on this structure was completed by the middle of May, 1928; although according to the schedule, it was to be the later of the two to reach completion.

THE eastern caisson presented a more difficult task. Below the river bottom was a thick strata of treacherous, rubbery clay of uneven thickness with a rock bed 60 feet deeper than the bed nearer the wester shore. Work on the easternmost caisson had proceeded without mishap until the concrete structure had penetrated to a depth of about 70 feet below the surface of the river—10 feet into the mud.

Suddenly, on July 27, 1927, the huge caisson slipped. The eastern edge of its bottom sank quickly through the mud, tilting the whole structure sharply to the east, and coming to rest only when it had careened to an angle of 45 degrees from the perpendicular.

Here was real trouble. Approxi-

stances, the only thing to do was to bring the sunken, tilted caisson back to the perpendicular. A task of that nature, of such size and presenting such handicaps, probably never had been attempted. There were no precedents by which to be guided.

The first thing attempted was the tying of four pontoons to the submerged eastern edge of the top of the sunken structure. Their total lifting

ing it back to position could proceed. To compact the mud, 6000 cubic yards of crushed stone and gravel were dumped on the river bottom adjacent to the east side of the caisson. Some attempt was made to compact this gravel by ramming it with a pneumatically driven hammer. It had little more solidifying effect than would the pushing of a toothpick into a pile of sand.

Next, huge wooden cribs, each filled with 200 tons of crushed stone, were hung from the top corner jutting out of the water, the cribs themselves being at a point sufficiently far down to be below the center of gravity of the caisson. The purpose of this was to exercise a push against the caisson's western side. Then a start was made to build covers on four of the east pockets so that the air therein could be removed. After several weeks of preparation, this plan was abandoned. The next step was to build a cofferdam with the idea of pumping the water out of the caisson, but this idea was abandoned before the cofferdam was completed.

NONE of these efforts, however, showed any reaction whatever. Late in December ice in the river seriously handicapped the work and no real progress was to be expected until weather conditions became more favorable. It was not until March 15 that



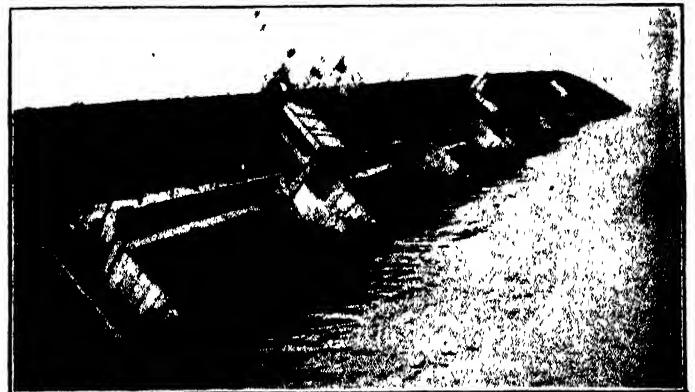
THE TILTED CAISSON

After the slip. The steel superstructure for purpose of pouring concrete was still in place



JUST BEFORE THE SLIP

This snapshot was taken the day before the accident. The height above the water is indicated by the barge's smokestack in the foreground



WHEN HOPE WAS LOWEST

With so little above the water and so much in the mud below the river bottom, prospects of righting the careened structure seemed almost nil

mately 250,000 dollars had been spent on this caisson and it had slid dangerously, almost hopelessly, from its proper position. It was too big to be destroyed and replaced by another, because it was in the spot where any new caisson would have to be sunk, and the enormous task of destroying the present unfinished caisson would so wreck the river bed that no other pier could be erected on the immediate spot. And no other spot would do, because not only was the western pier nearing completion but the abutments on shore to which the cables were to be anchored had been finished months before. Under the circum-

stance of 400 tons had no more apparent effect than the flipping of the fin of the tiniest minnow which swam around the mountain of concrete and steel that had invaded his home.

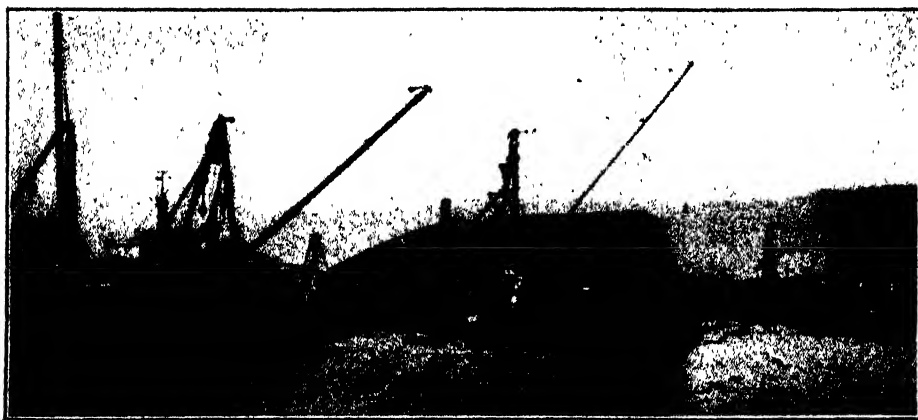
FEARS were entertained that the sucking effect of the mud would seriously interfere with the work of correction, and to disintegrate it 100 sticks of dynamite were planted in the river bed. When they exploded the only appreciable effect was to break the fastenings of the pontoons.

Would the caisson settle still more? This was something that must be taken care of before the work of bring-

the ice finally went out and work was resumed.

A deep trench was then dug out on the west side of the caisson. Then divers began jetting. In this operation a jet of water under high pressure is played against the mud to wash it away. Two jets were used, operated by electrical pumps, each of them having 150 pounds pressure at the pump, which meant about 125 pounds pressure at the nozzle. One delivered 1250 gallons per minute and the other 2500 gallons per minute. In this way, mud in the center pockets was washed out and deposited in the trench.

Next drag buckets dragged the mud



SLOWLY THE CAISSON MOVES

Surrounded by floats and booms with weights in suspension exercising constant strains, the big caisson began to move after ten months' effort, at first only two inches a day being recorded

from the bottom of all the pockets on the northwest, west, and southwest sides of the caisson.

During the autumn, before ice formed in the river, six cribs, each of them holding 200 tons, had been sunk in the river and hitches made with blocks and falls over gallows frames set up on railroad car floats. These weights, in constant suspension, were for the purpose of exercising a constant strain against the settling of the caisson.

TEN 70-foot booms of 18 by 18-inch timber were placed at right angles to the upper side of the caisson and from each of these booms a 50-ton weight was hung.

With all these contrivances calculated to let the force of gravity pull the structure back into position, additional efforts were necessary to move some of the structure in the mud and some of the weight in the form of concrete itself. Immense drag-line buckets were carried down, each of them looking like some giant horse-

shoe crab, to pull out the mud and rubble which collected in the pockets. Excavations were made in the concrete to dig out the mud from under the upper corner of the bottom.

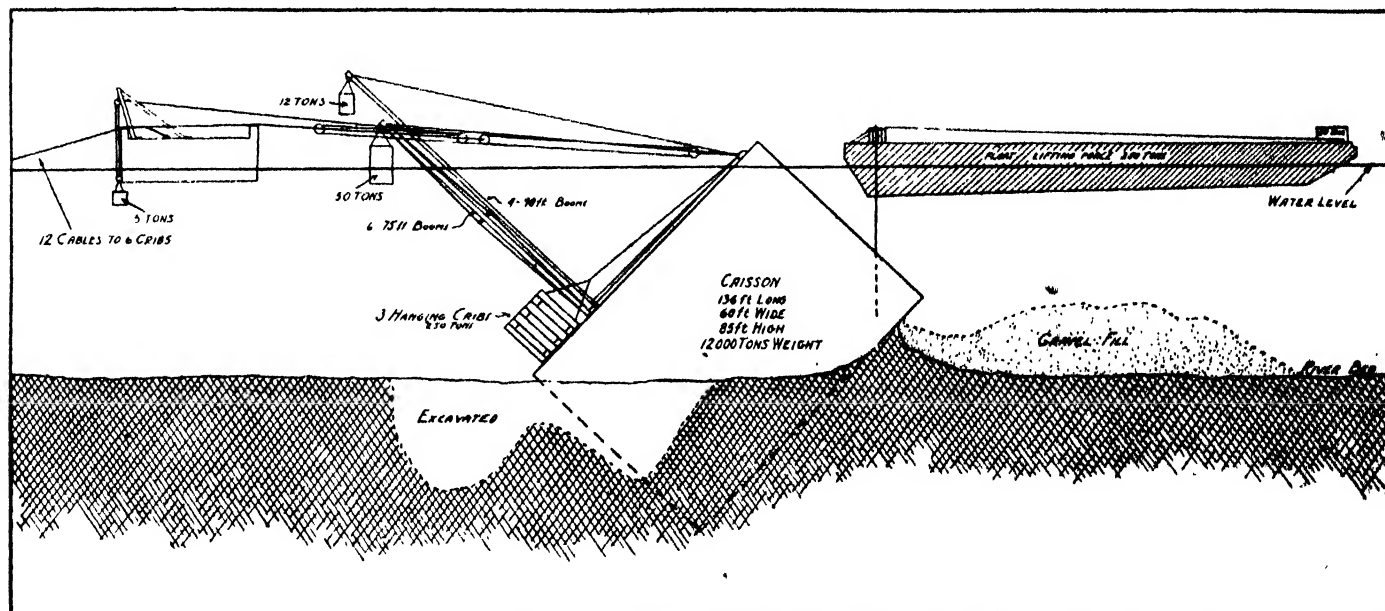
Early in May, the structure began to move, the first perceptible movement being on May 7. For some time, although the force was working 24 hours a day, a movement of only about two inches a day was made. This progress, however, was satisfactory. More and more the structure was pulled up towards the perpendicular and, as time went on, progress was faster. By July 10th the caisson had been pulled back a total distance of about 30 feet. The structure was now at a point where the top corner had passed the center of gravity and gravity was working with the engineers instead of against them. From then on progress was comparatively rapid, sometimes a movement of as much as two feet in 24 hours being effected. Steadily, surely, the giant caisson was pulled back towards the perpendicular so that once again the

concrete might be poured in and the cutting edges once more begin sinking straight down through the river bottom to bed-rock as the work on the bridge proceeded.

The progress of the work has been measured by triangulation. A rock about 100 feet high is on the eastern shore of the river nearly opposite the caisson. On top of this a man was posted with a surveyor's transit. He trained his instrument on a fixed point on the shore and on another fixed point on the small edge of the caisson visible above the water.

THE slightest variation in the angle of the two lines gave him the data he needed for registering any movement, even to the fraction of an inch. Beside him stood a large wooden board with the face of a clock painted on it. The circumference measured 12 feet. One of the two moving hands, painted black, recorded progress in feet. This corresponded to the hour hand of the clock. The other hand, painted red, corresponding to the minute hand, recorded inches. As progress was noted, the watcher moved the hands of the clock forward to inform the workers out in the river of the progress they had made.

Months had been lost by the catastrophe. Two hundred thousand dollars had been spent in setting the concrete pile aright again. The public would have to use ferry-boats for a year longer than had originally been expected, instead of motoring rapidly across the broad Hudson by January 1, 1929. But the engineers rejoiced. They saw themselves accomplishing successfully one of the most difficult feats of corrective engineering ever attempted in the age-long effort of man to conquer Nature.



HOW IT WAS ACCOMPLISHED

The three hanging cribs, the cranes and the barges all helped; after the caisson was drawn back to a position where gravity acting directly

on the caisson was working with them instead of against them, daily progress began to be measured in feet instead of in scant inches

Household Inventions



APPLE CORER

Too often apple corers are made of cheap metal and the cutter is curved so that it does not withdraw the core. This new corer from England is of finely tempered steel and has a circular cutting edge that brings out the core when cut.—*Lewis and Conger, 46th St. at Sixth Ave., New York*



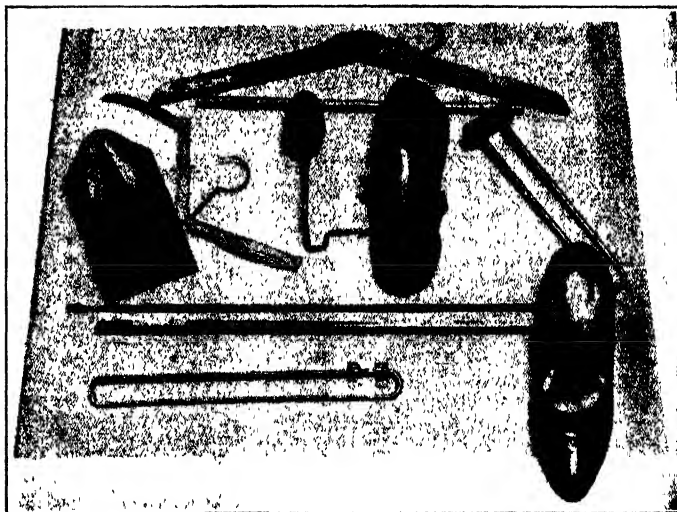
← WATER POWER BEATER

This simple device eliminates much of the tedium of the kitchen and does a better job of beating eggs, cream, et cetera, than the ordinary hand beater. When connected to a faucet, and the water turned on, the beater does all the work in a few minutes. A distinctive feature of this new water power beater is that the water turbine housing is small, and a large cooking vessel may easily be placed underneath. *Lewis and Conger, 46th Street at Sixth Ave., New York*



BREAD SAW

Many bread knives are made with saw teeth and most of them are efficient enough for cutting ordinary bread, but this new one is in all reality a saw. It is almost exactly the same as the hack saw commonly used in machine operations, but the frame is much nearer the blade and is thinned into a wedge so that it will "follow through." It is especially adapted to the job of cutting fresh, soft bread and is said to work more rapidly and do a better job than most bread knives now on the market.—*Lewis and Conger, 46th St. at Sixth Ave., New York*



▲ CLOSET ASSORTMENT

A selection of hangers and racks which costs but 80 cents. At the top is a clothes hanger, the shoulder arms of which fold down against the trouser rod; at the left below is a hanger that folds compactly for carrying in the envelope; in center is a shoe rack made of nickel-plated steel tipped with a wooden toe and so bent that when screwed to the wall, the toes hold shoes as shown; and at the right is a loop upon which hangers may be hung. Below is a metal strip which holds shoes by the heel, and at the bottom is a loop for attaching under a closet shelf.—*F. W. Woolworth Company.*

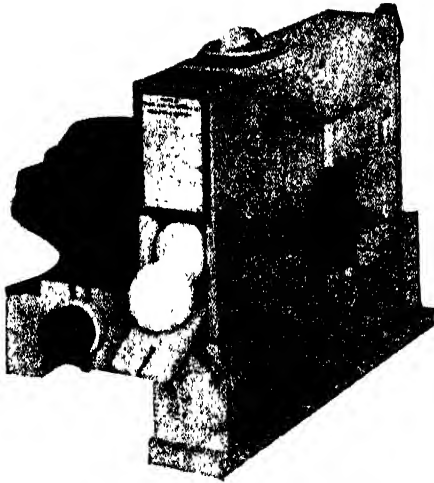
SCISSORS SHARPENER

← The average sharpener for scissors is quickly dulled past satisfactory use or perhaps it is too small for safety. This new one imported from England is made of fine steel and has a handle large enough to eliminate the danger of cutting the hands when the device is being used.—*Lewis and Conger, 46th St. at Sixth Ave., New York*



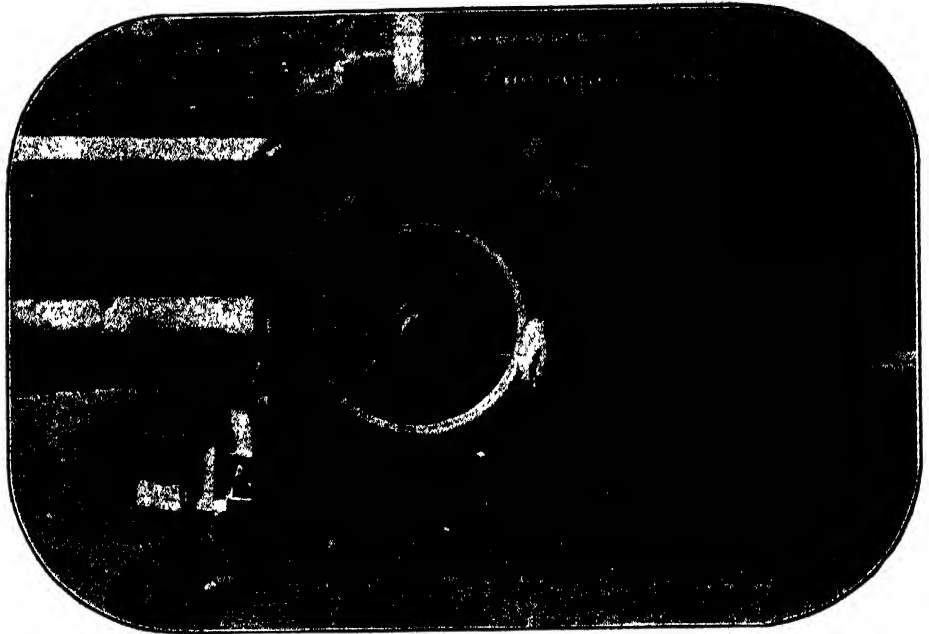
Inventions

New and Interesting



TENNIS BALL RE-NAPPER

Tennis balls that have been used until the nap is worn so that they "sail," out of control, may be quickly re-napped and whitened with this machine. They are then as good as new unless already "dead".—*Tennis Ball Renapping Machine Company, 52 California Street, San Francisco*



PORTABLE MOTOR-DRIVEN AIR PUMP

This complete unit, weighing only 40 pounds and easily moved from place to place by hand, has a displacement of one and one half cubic feet per minute and will deliver compressed air at pressures up to 75 pounds. Attached to any electric light socket or base plug, it can be used to pump tires, blow out gas lines, for spray-painting, et cetera.—*Demco, Inc., 105 S. Calvert St., Baltimore*



NECKWEAR PRESSER

A new press to take the wrinkles out of neckties. Ties are inserted between the covers of the book in which there is a heating element; they are then dampened, the covers are closed and clamped tightly, and the cord attached to a light socket. After the current has been turned on for about five minutes, the tie is removed. The device presses the lining as well as the surface.

—*Hare Mfg. Co., 600 S. Delaware Ave., Philadelphia*



UNIQUE "SCYTHE" >

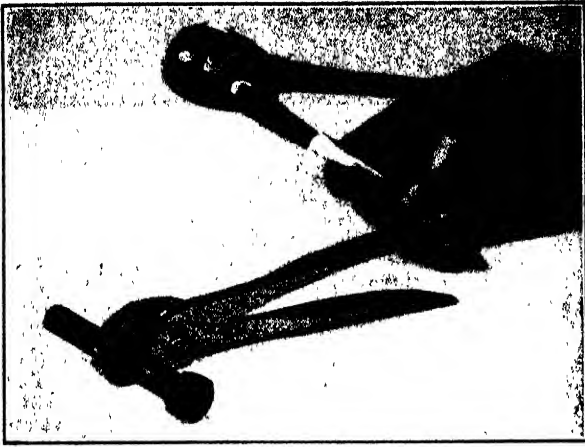
The device illustrated is but one of several models of a scythe built somewhat on the principle of the golf club. The person using it stands erect and, with a light swinging motion can trim the edges of lawns or chop weeds with little effort. It is light and serviceable, and the cutting blade is

double-edged so that it will cut with either a forward or backward stroke. Other models (not shown) have only one leg which terminates in a bent, double-edged cutting blade.—*The Village Blacksmith Folks, Watertown, Wisconsin*

< BOOK LIGHT

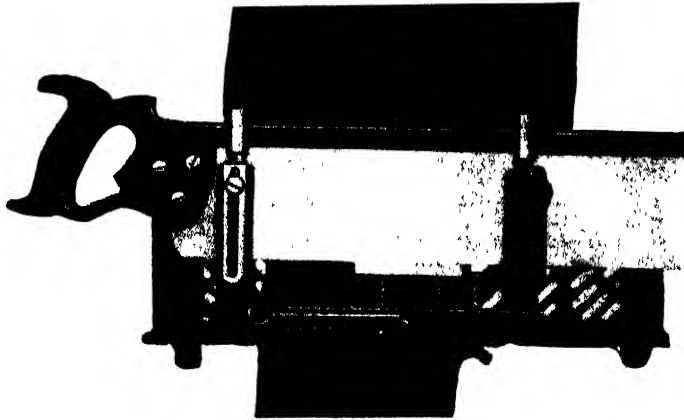
Many people find a bed clamp light inconvenient and unsatisfactory. This new light is unique in that it clamps directly to the book and gives a satisfactory light on the printed page for the person who likes to read in bed or some out of the way corner. It can be connected to any standard light socket, and is said to give just the right intensity of light.—*Melodelite Corporation, 132 Nassau Street, New York*





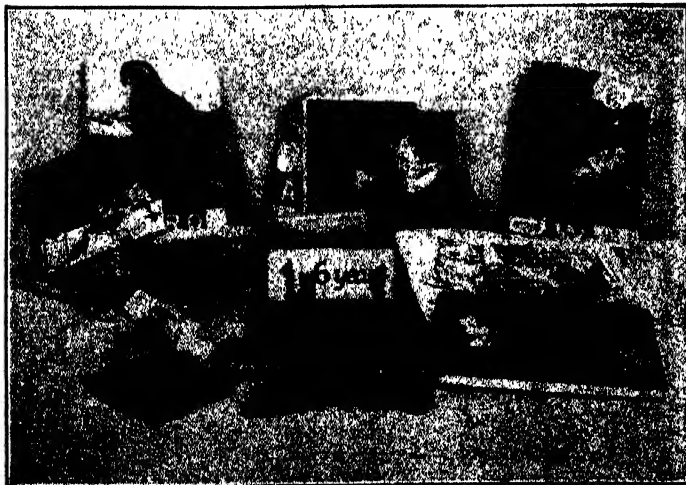
PLIER WRENCH

Made of high quality steel, forged and specially treated, this new plier wrench is equipped with jaws that are made to fit hexagonal nuts in a large range of sizes. It may also be used on square nuts and on pipe. It has good leverage and will grip the job without chewing off the corners. For quick work, it takes the place of a ratchet wrench. It is readily adaptable to all sorts of rapid work, especially that of battery men.—*Bear Mfg. Company, Rock Island, Ills.*



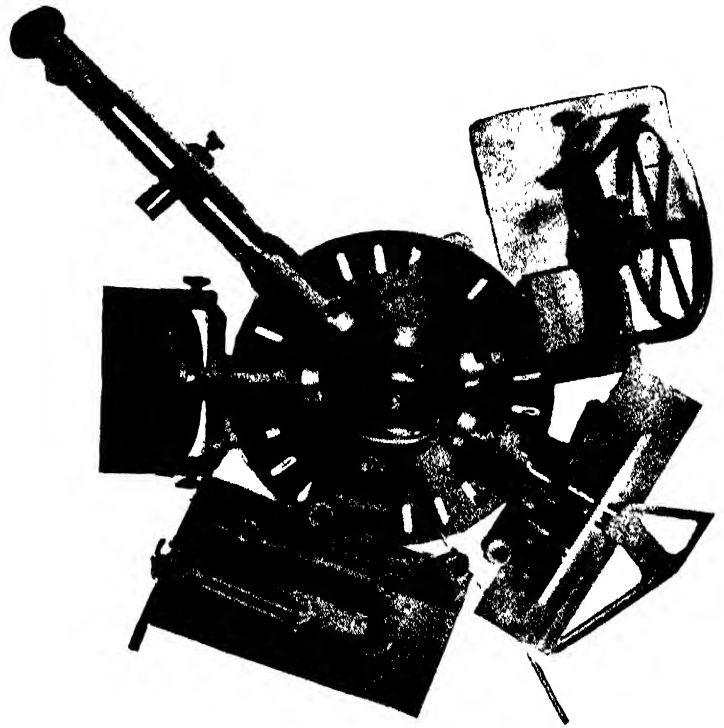
COLLAPSIBLE MITER BOX

For the workman who must follow his job from place to place, this new miter box fills a long felt need. It folds compactly so that it may be packed away among other tools without taking too much space. On the job, it is adjustable by means of the wing nuts and the screws illustrated here.—*Goodell Pratt Company, Greenfield, Mass.*



ASSORTMENTS OF TOYS FOR CHILDREN WHILE TRAVELING

At the left is shown an assortment of toys selected for the child of four to six years of age. They are suitable for a railroad journey since everything is noiseless and requires



A WOOD-WORKING MACHINE

This machine is a composite of wood-working units, all cleverly arranged on a circular steel table to conserve space. This photograph was taken from above to show, from upper right in a clockwise direction, the band saw, the jointer, the rip saw, the sander, and the lathe. One centrally located electric motor, which can be connected to an electric socket, drives any one of the units by means of a multiple fingered machine clutch.—*The Utility Machine Co., Cleveland, Ohio*

WOOD CARRIER

It's a simple matter to carry a heavy load of wood to one's fireplace with this flexible, light-weight leather carrier. It is made of well-tanned cowhide attractively studded with copper rivets.—*Home and Campercraft Co., Plimpton Building, Hartford, Connecticut*



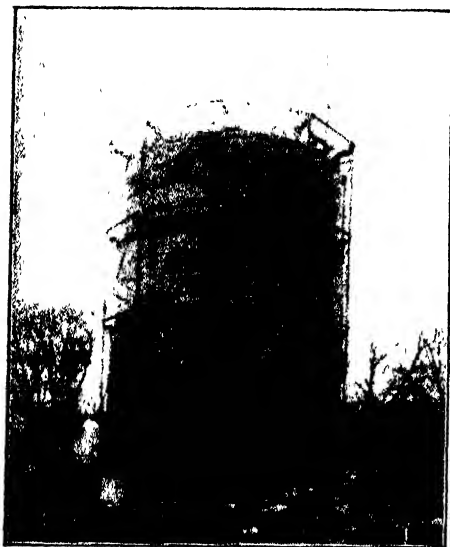
little space. At the right is shown a group suitable for the child of six to eight years of age, and adapted to use on board ship.—*R. H. Macy Company, New York*

The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

All Welded Gas Holder

THERE has just been completed at Albion, Michigan, the largest all electric-arc-welded low-pressure gas holder ever built. The construction and design are both the work of the Western Gas Construction Company of Fort Wayne, Indiana. The holder with all lifts elevated to their



This huge gas holder with a capacity of 300,000 cubic feet of gas, is the largest ever built entirely by an electric arc welding process

maximum height stands 113 feet seven inches above the foundation. It has a diameter of 74 feet and weighs 516,385 pounds plus the weight of the welding rod that was used. The gas holder has a capacity of 300,000 cubic feet of gas at a water pressure, when full, of 12 inches.

Building a gas holder by electric arc welding has inherent practical advantages that recommend it strongly. It simplifies construction and reduces fabricating cost. When a gas holder is made of riveted plates it is necessary to employ the tank shop to lay out and punch all the members. When electric arc welding is used it is only necessary to lay out and punch the mem-

bers in the shop for fitting-up bolts. The plates are, of course, rolled to the proper radii in the shops. On this job the plates were assembled in position with bolts, and tack welded, with the exception of the cups and grips, which were fabricated in the shops, assembled in sections on the ground, and welded in place.

On this gas holder four tons of welding rod were used. If a holder of the same size were made of riveted construction seven and one half tons of rivets would be necessary. Four welders manufactured by The Lincoln Electric Company, Cleveland, Ohio, placed 21,414 lineal feet of welding. The entire job was carried through almost without a hitch and with much less difficulty than would naturally be expected with a new structural process.

Radium Rays Test Flaws in Castings

USING radium rays so penetrating that they can go through pieces of 15-inch metal to test for hidden flaws in large castings, is one of the latest accomplishments of the Russian State Radium Institute, Leningrad.

These "gamma rays," as they are called, are similar to X rays, but are of much shorter wavelength. They are more penetrating and can pass through pieces of metal too thick to be examined with the X rays. Examination by radium is said also to be cheaper than with X rays, because the same radium can be used over and over for an indefinite time.

Large and expensive photographic plates are not required, since the rays, after passing through the object, act upon a special, sensitive electroscope. The test record is preserved for future reference in the form of a simple diagram automatically traced. Another advantage is that gamma rays speed up the inspection—it may be cut down to a couple of minutes for a large casting—while X rays require a very long exposure, often of several hours, when metal is more than two or three inches thick.

The apparatus, as developed by the Russian scientists, is very simply constructed. A tiny glass capsule with a

radium preparation is inserted into a deep hole bored in a large lead ingot. This ingot stops all rays, except a narrow strong beam that goes along the bore. This beam pierces the casting and encounters two filaments charged with electricity and enclosed within a copper cage. There is an air space between the filaments and the cage which acts normally as a perfect insulator, allowing no electric current to pass through it. But as soon as gamma rays have a chance to get in the cage they ionize the air and turn it into a conductor.

Electricity from a battery flows from the filaments to the copper cage and from it passes through a galvanometer and back to the battery.

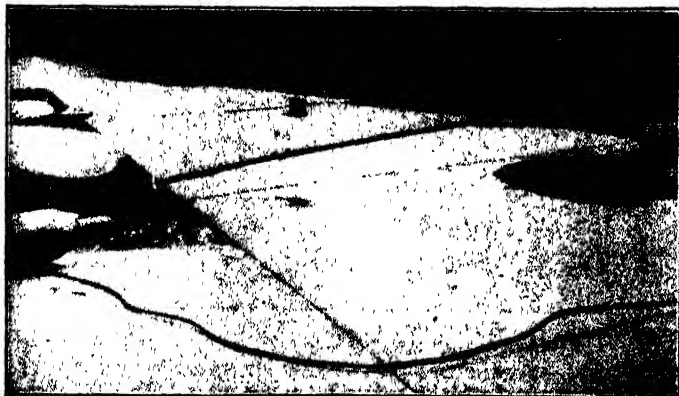
As the intensity of the rays changes with the thickness of metal pierced by them, the rate of ionization varies accordingly. Therefore the flow of electric current exactly mirrors the shape of the object under test. Any deviation at once shows that some imperfection is present.—*Science Service.*

First German Pulverized Fuel Locomotive

PREVIOUS endeavors to design pulverized coal locomotives have met with considerable difficulties, owing to the limited amount of space available. However, a new engine developed by the AEG Company, of Berlin, has given excellent results in actual operation, particularly in connection with pulverized lignite.

Preliminary tests had made possible the raising of locomotive boiler efficiency from 52 percent with normal firing to 67.5 percent with pulverized fuel, and with an hourly load on the heating surface of 70 kilograms per square meter of surface. Difficulties associated with combustion and the production of slag were overcome by the use of convenient nozzles for breaking up the pulverized fuel.

Outwardly, the new locomotive does not present any distinctive features, except for the peculiar design of the tender, which is entirely enclosed and, in the place of a coal bunker, comprises a horizontal cylindrical tank measuring about six feet, six



The finished floor of the gas holder. The neatness of the welded seams and the absence of rivets will be noted



As the work progressed. Just below the workman, who is welding a gas-tight seam, is the electrical apparatus

inches in diameter by about 13 feet in length. It has a capacity of about 423.8 cubic feet, sufficient for accommodating six tons of lignite.

The two conveying screws supplying the pulverized coal to the locomotive nozzles are capable of dealing with a maximum of 4680 pounds per hour at a maximum rate of 140 revolutions per minute, the amount of fuel actually supplied being controlled by the number of revolutions made by these screws.

Primary air is supplied by a blower driven by a simple steam turbine and paddle wheel, its maximum output being seven horsepower. A small steam engine is used to drive the slowly-rotating conveying screws. A small auxiliary burner at the rear wall of the ash pan serves as an igniter while the locomotive is stationary or when coasting, and is intended to make up for the radiation losses of the boiler and for supplying steam for the air pump. The tender loaded with pulverized coal weighs about 3.8 tons more than a standard locomotive tender of the same class.

The air-pulverized coal mixture blown into the firebox comprises only a part of the air required for combustion in the form of primary air, the balance, or secondary air, being drawn in automatically, as in an ordinary steam locomotive, by the stack draught. The mixture is blown into two long nozzles facing one another below the firebox. There it is dissipated into a large number of narrow streams or bands. These are formed at an angle of 90 degrees, so as to strike one another in the center of the firebox, where a violent vortex is produced.

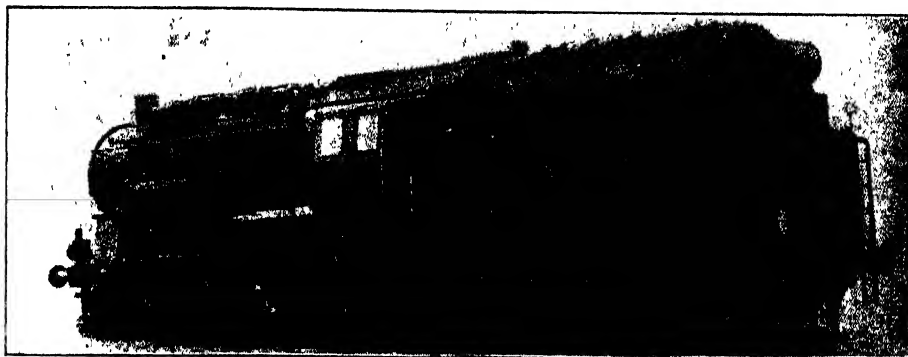
The rising pulverized-fuel flames strike the strongly preheated secondary air below the brick arch. The heated gases are deflected upwards at the end of the long arch at a very high speed, thus causing the slag particles to be granulated on the upper surface of the firebox, so that no slag clings to the tube orifices.

After a few trials running idle, the two pulverized-fuel locomotives so far constructed were put to work hauling freight trains on the usual schedules on one of the sections of the main lines. During the trial runs it sometimes happened that pulverized lignite and ordinary pit coal were stored above one another in the tender. This never gave rise to any inconvenience, although a change over from one fuel to the other was effected during a journey.

The main advantages of the new system are that the fuel cost is reduced by the possibility of using lower grade fuel, particularly peat or lignite, and by the ease with which a change-over may be made from one kind of fuel to the other. The time required for cleaning the firebox is reduced to a minimum, and there are no fuel losses in discharging the slag. Thus the duration of a continuous run is limited only by the capacity of the coal bunker.

floor of the Bell Telephone Laboratories in New York and through the medium of a telephone commanded the activities of two men who stood before the transmitting apparatus several stories above on the roof, and whose images were clearly visible on the screen before him. The demonstration left the impression that the long-sought transmission of public events into the home was measurably nearer.

The reader is doubtless familiar with the



Courtesy Railway Age

The successful pulverized coal locomotive recently built in Germany

Smoke emission is reduced to a minimum, and spark throwing is practically, if not entirely eliminated. Greater cleanliness is secured for the driver and fireman, and the call upon the fireman's physical exertions is lowered considerably.—Written especially for SCIENTIFIC AMERICAN by Dr. Alfred Gradenwitz.

Out-of-Door Television—The Latest Advance

BRINGING television out of doors is the feat most recently performed by the scientist-inventors, Dr. Herbert E. Ives and Dr. Frank Gray of the Bell Telephone Laboratories in New York. Their apparatus will now enable one to follow the motions of a prize fighter, the activity of an athletic contest, or the gestures of a presidential candidate at the same time that his voice is heard over the radio. Heretofore the view has been limited to that of a face or moving hand held close to the transmitting apparatus and "scanned" by means of a rapidly moving pencil of light.

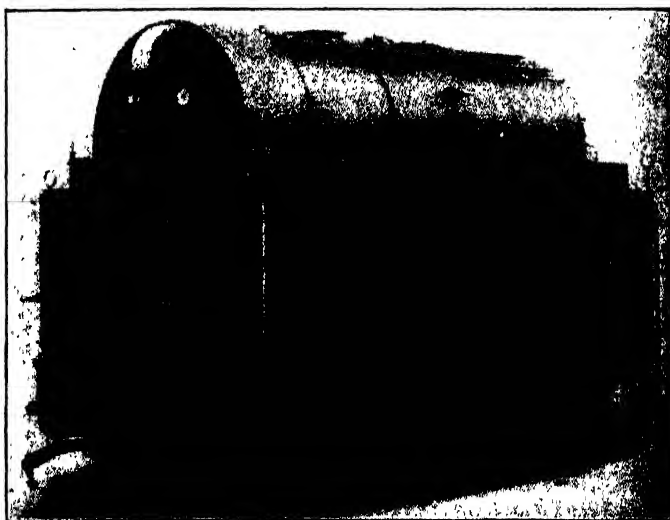
The new modification of the Ives television system was recently seen by a representative of the SCIENTIFIC AMERICAN, who sat in a darkened room on the seventh

Ives system of television, as it has been widely described before. It will be recalled that the object to be transmitted was placed immediately in front of a revolving disk of metal having a single spiral of small holes drilled around its outer edge. Through these holes shone a powerful beam from an arc light. The method of scanning the object was most clearly demonstrable by first stopping the motor which caused the disk to revolve. When this was done a single spot of light, and only one, was seen to be reaching the object. By slowly turning the disk over by hand this spot was made to traverse the object from side to side, but just as it passed off from the object at the left a new spot was seen to follow it on at the right. This new spot of light, however, was slightly lower, for the pencil of light passed through a hole slightly nearer the center of the disk. The third spot, in turn, traversed another parallel path across the object; and so on for the fourth and all the remaining paths, the whole process being repeated with each revolution of the disk. By starting the motor this process could be followed by the eye until, as the motor speeded up, it became too rapid for the eye to follow,



Courtesy Railway Age

The boiler of the pulverized coal locomotive, under construction, showing nozzle and ash pan structure



Courtesy Railway Age

The tender of this locomotive is built in the form of a tank to carry the previously pulverized prepared fuel

or even for the mind to conceive. One knew, however, that the beam of light was scanning every inch of the surface of the object many times a second, and that every variation in light reflected from that object, caused a corresponding variation in the electrical current flowing through

an entirely different quarter of the world. "While on a cruise in April of this year to the Galapagos Islands, we came upon a party of 32 men marooned on James Island. They had been there for several months, had used up all their supplies, and were then living entirely 'on the country,'

tion. These shoes were fastened with thongs of seal skin, since no other material was available. They were extremely useful on the rough lava flows which furnish about the only highways of communication on that desolate island. Probably the prior use of these old tires had been as bumpers on the row-boat with which the men were equipped."—Leslie Watson.

Synthetic Vinegar Lacks Vitamins

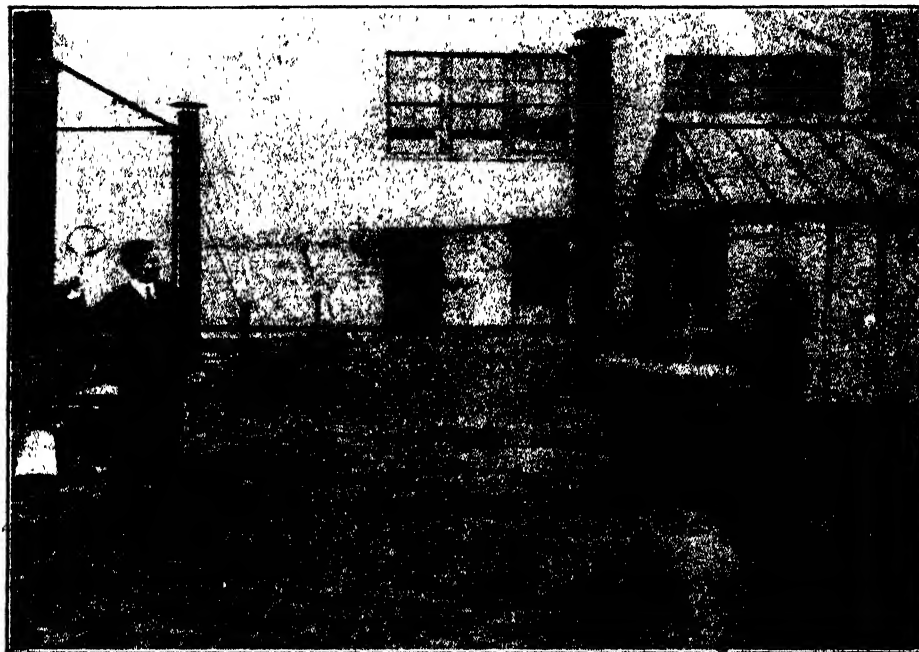
VINEGAR made by the old-fashioned fermentation process is far superior to synthetic acetic acid, German scientists have found. While all vinegars vary greatly in their vitamin content, the synthetic variety is lacking in vitamin D, the important food factor that prevents rickets in children, report Dr. A. Janke and H. Lacroix.—*Science Service*.

Bronze-welding Cast Iron

BRONZE welding, although desirable at times, is often unsatisfactory because the bronze filler can seldom be made to adhere to, and form a strong bond with, the iron. Furthermore, the joint usually has to be made bulky and unsightly in order to give it strength.

The Simplex Flux and Solder Company has developed a method of welding cast iron that, according to reports, makes possible the practical welding of two different metals with a filler foreign to both, yet without destroying the base structure of any of the three. It is called the Lotan combination powder and flux method.

The equipment used in welding by this method is the ordinary oxy-acetylene torch, bronze or brass filler rod, and the Lotan combination which consists of a special powder preparation and a special flux. In operation, the pieces are laid together and the edge or joint is heated just above black heat. The powder is then sprinkled over the joint so that the torch may blow it into the surface of the iron. After heating this properly, the brazing rod, which



The transmitting apparatus for the Ives-Gray out-of-door television system installed on the roof of the Bell Telephone Laboratories in New York City

the large photoelectric cells in the immediate vicinity.

Doctors Ives and Gray have now made certain variations in that simple process which enable outdoor objects to be transmitted. Obviously the object is constantly illuminated all over, and not by a moving beam, as previously, since it is now illuminated by the Sun.

The scene or event to be transmitted is reduced to the form of an image by a large lens, this image being exposed to a single photoelectric cell through a rapidly rotating disk similar to that previously employed but several times as large. The lens serves somewhat the same purpose in the television apparatus as the large lens of an astronomical telescope, and, like the latter, it should be large to gather as much light as possible.

The experiments show that moving persons and objects can be successfully "televised," although at a considerable distance from the lens and therefore in such a position that the focus of the lens does not require changing from moment to moment. An improved photoelectric cell is used, the disk of the new apparatus is larger (38 inches in diameter) and with its 50 holes drilled in a spiral it rotates at the rate of 18 revolutions per second, but there are no essentially new elements in the apparatus except the lens.

Further Light on the Use of Old Tires

THE following excerpt is from a letter recently received by the editor. It interested us very much so we asked and received the writer's permission to publish it.

"Your short item and photograph on page 541 of the June issue regarding the use of old tires for shoes by the peasants of Macedonia, leads me to mention a similar use of them, through virtue of necessity, in

their principal articles of diet being ducks, turtle's eggs, and flamingoes—a rather unusual combination. They had been left on the island to mine sulphur from some of the volcanic craters there but, some mishap having occurred to the ship that had brought them, prior to its return to Guayaquil, they had been entirely without supplies or visitors until we came along.

"A number of these men were shod with shoes very similar to those in your illustra-



This photograph shows the ease of bronze-welding cast-iron fittings to steel, a job hitherto considered by engineers to be impossible of accomplishment

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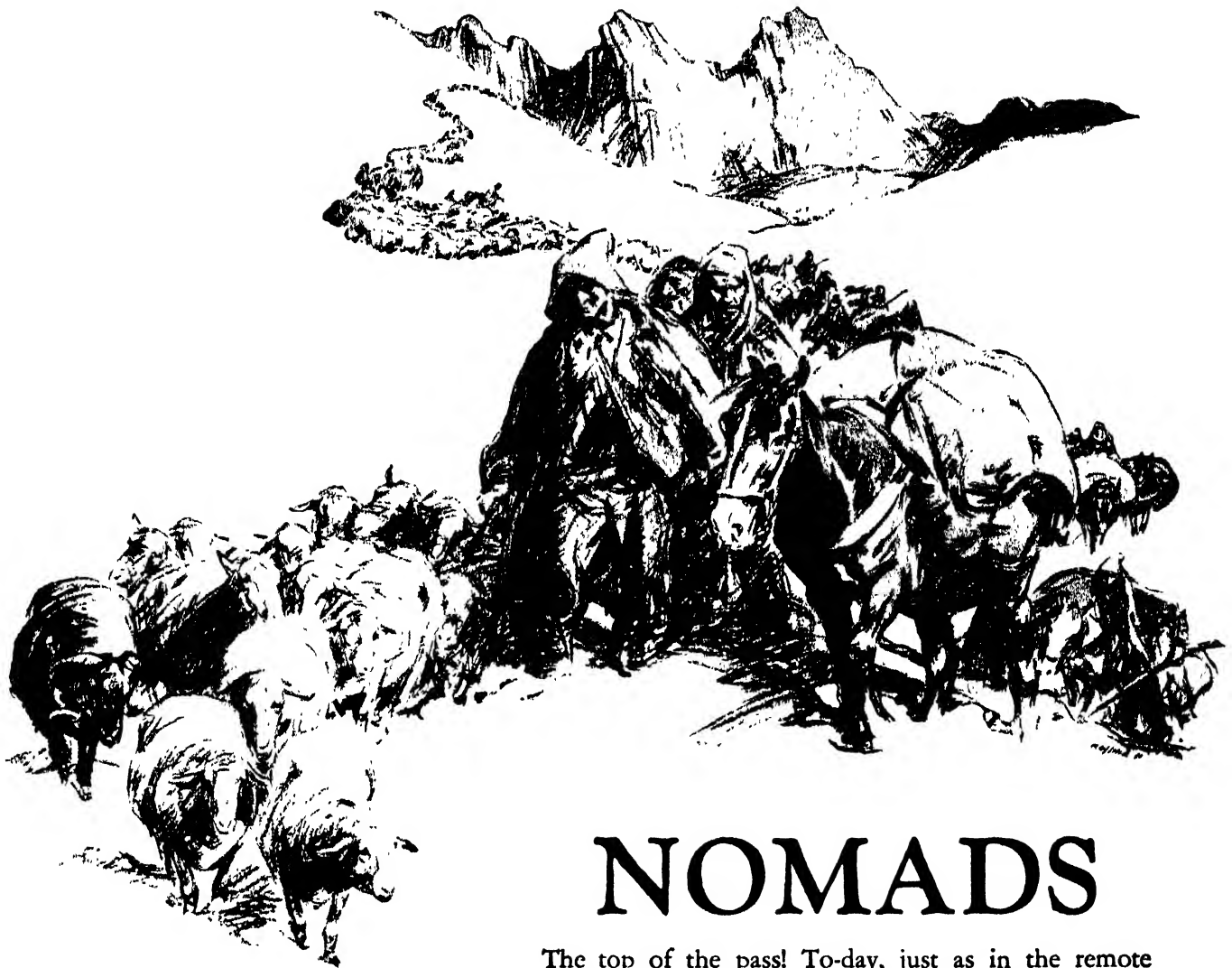
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Yet, as Thomas A. Edison has written, "The electrical development of America has only well begun. So long as there remains a single task being done by men and women which electricity could do as well, so long will that development be incomplete."



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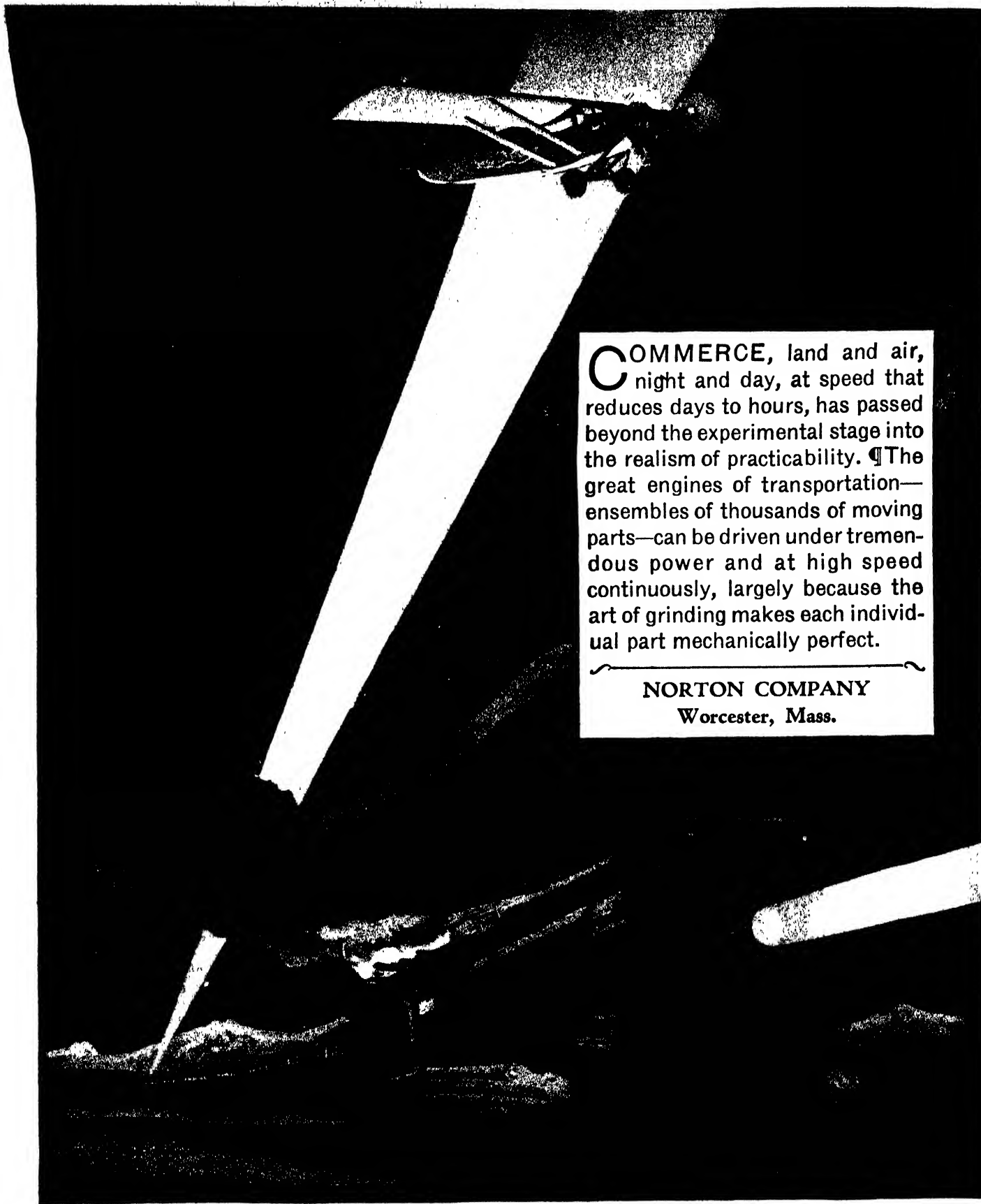
Edited by ORSON D. MUNN

Eighty-fourth Year

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Plier Wrench	253	For our cover illustration this month, our artist, Howard V. Brown, has strikingly depicted an Australian native in ceremonial dress. The mask and headdress, as well as the design on the chest and arms, is made of tufts of cotton stuck in place with human blood. These interesting natives are dealt with in more detail in the article starting on page 201. For the data for preparing the cover we are indebted to the book, "Native Tribes of the Northern Territory of Australia," by Sir Baldwin Spencer, published by The Macmillan Company.	
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COMMERCE, land and air, night and day, at speed that reduces days to hours, has passed beyond the experimental stage into the realism of practicability. ¶The great engines of transportation—ensembles of thousands of moving parts—can be driven under tremendous power and at high speed continuously, largely because the art of grinding makes each individual part mechanically perfect.

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Looking Ahead With the Editor

In a Dog's World

JUST how intelligent is the family pet dog that does a few "tricks"? What constitutes intelligence in a dog, anyway? Does he understand words, or does he simply interpret inflections? Can he ever be taught to talk? These and similar questions will be discussed at length in an article that is scheduled for early publication. Look for this feature which will give you a new understanding of the psychology and life of the dog.

Excavating in Transjordan

MORE about Montfort, the crusader's castle in the Holy Land which was described in the February issue, is coming in an article written by the director of the expedition. In this article—which is almost a "travelog" because of the wealth of interesting travel notes it contains—details of the excavations are given, and much is told of Transjordan and of Jerash which is to be excavated at an early date by Yale University in co-operation with the British School of Archeology.

Wooden Highways that Carry Rivers

IMAGINE a pipe-line made of wood and large enough to carry an entire river! The Romans made their pipe lines of wood by burning out logs, but modern man makes his on a larger scale by fastening staves together to form a pipe 12, 14, or 16 feet in diameter. Read in an early issue the details of this stupendous engineering undertaking—how the pipes are made and then installed, winding across country like enormous snakes.

Underground Animals

CRAWLING through extremely narrow, slimy passages, Dr. Noble of the American Museum of Natural History found what he was looking for in the vast caves of the Ozarks: blind salamanders. He found blind crayfish, myriads of bats in a noisome cavern, and caught 100 salamanders which he brought to New York for further study. His story of the exploration, tinged with the spice of high adventure, will be published soon.

The Kubus

PRIMITIVE almost beyond belief, filthy, diseased, and lazy, a tribe of Kubus, found in the Dutch East Indies and studied by an ethnographer, was so unwholesome as to be obnoxious even to the Malay guide. The article describing these people and telling something of their habits, now ready for publication, is more than a scientific document—it is a picture of a people pathetically child-like and backward. Be sure to look for it.

Every Issue Fully Illustrated

Great minds, they say, run in the same channels. Many minds universally conceded to be among the greatest read **SCIENTIFIC AMERICAN** regularly. Do you? A subscription is only four dollars a year.

Among our Contributors

Elihu Thomson



In the world of science and industry, there is no scientist or technical man who is so highly regarded as Dr. Elihu Thomson. At the age of 75, after having made over 700 inventions during an active life, he retains active directorship of the research laboratory at Lynn, Massachusetts. As long ago as 1875, he anticipated Hertz by transmitting spark signals over a distance of 100 feet, a fact not generally known.

Capt. Nelson H. Goss, U.S.N.

With zeal and energy characteristic of one who was on the varsity eleven and the varsity crew at the Naval Academy, from which he was graduated in 1905, Captain Goss has applied himself to the study of naval questions, and is well fitted to speak authoritatively on the subject. During the World War he commanded destroyers and destroyer escorts. He is a graduate of the War College and a strategist of high standing. Follow his articles closely.



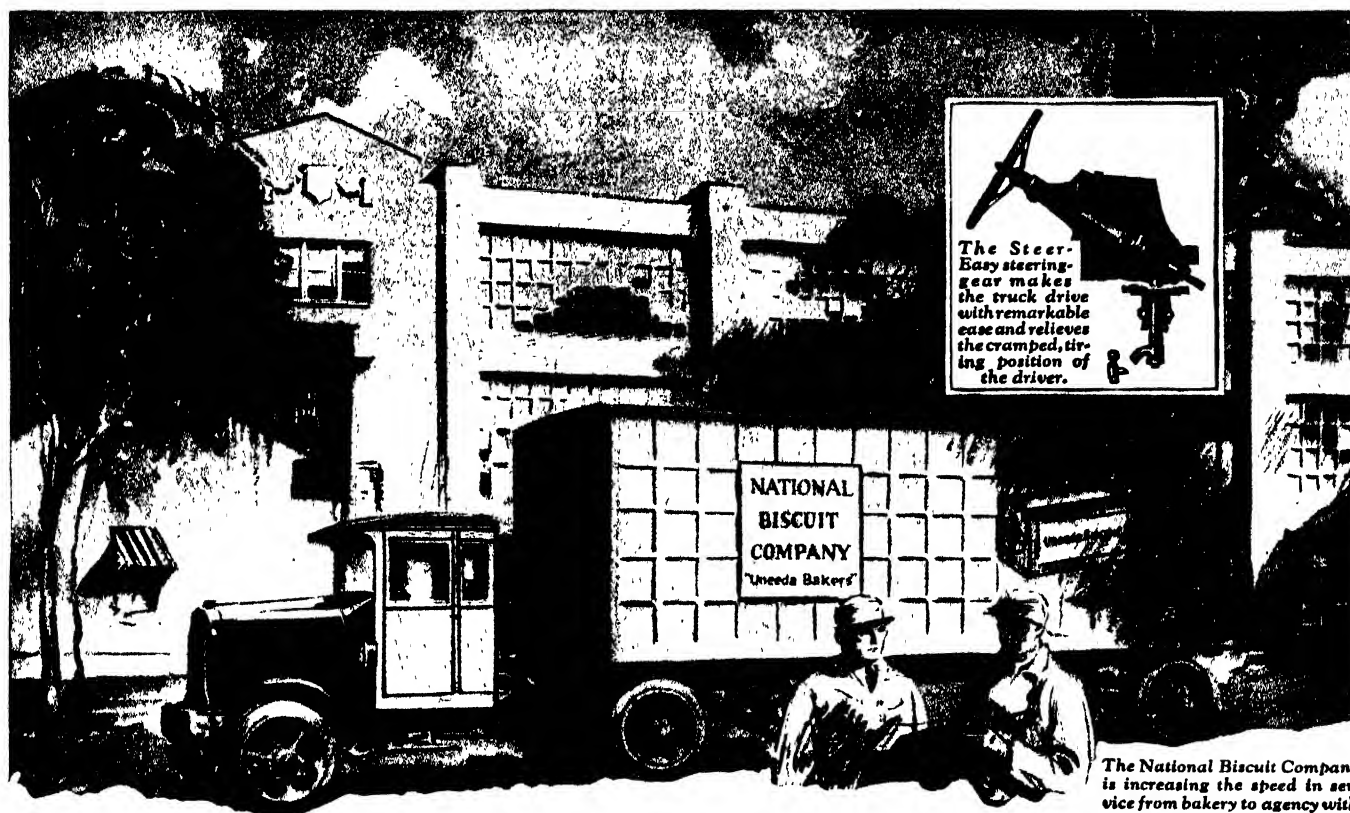
Clark Wissler



Besides being a scientist of outstanding accomplishments in anthropology and psychology, Dr. Wissler is perhaps a better museum man than some others in like positions. As Curator of Anthropology at the American Museum of Natural History in New York City, his enviable ability to combine his wide knowledge of scientific subjects and his fine grasp of museum methods is nothing short of genius.

James Stokley

Formerly a teacher, Mr. Stokley is now a staff writer and Assistant Treasurer of Science Service, a position to which he was appointed in 1925. He is a member of several scientific societies in the United States, England, and France. In his article about the cruise of the *Carnegie*, beginning on page 240, he corrects some popular fallacies concerning the construction of this non-magnetic ship and the purpose of its long cruise.



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Auburn, N. Y.	Chicago, Ill. (3)	El Paso, Tex.	Jacksonville, Fla.	Minot, N. D.	Providence, R. I.	Schenectady, N. Y.	Washington, D. C.
Aurora, Ill.	Chicago Heights, Ill.	Erie, Pa.	Jersey City, N. J.	Montgomery, Ala.	Quebec, Que.	Scranton, Pa.	Waterloo, Ia.
Baltimore, Md.	Cincinnati, Ohio	Evansville, Ind.	Joliet, Ill.	Montreal, Que.	Regina, Sask.	Seattle, Wash.	Watertown, N. Y.
Billings, Mont.	Cleveland, Ohio	Fargo, N. D.	Kankakee, Ill.	Nashville, Tenn.	Richmond, Ind.	Shreveport, La.	Watertown, S. D.
Binghamton, N. Y.	Columbia, S. C.	Fort Dodge, Iowa	Kansas City, Mo.	Nashville, Tenn.	Richmond, Va.	Sioux City, Iowa	Weyburn, Sask.
Birmingham, Ala.	Columbus, Ohio	Fort Wayne, Ind.	Knoxville, Tenn.	Newark, N. J.	Rochester, N. Y.	Sioux Falls, S. D.	White, Kan.
Bismarck, N. D.	Council Bluffs, Iowa	Fort Worth, Texas	Lethbridge, Alta.	New Haven, Conn.	Rockford, Ill.	South Bend, Ind.	Williamsport, Pa.
Boston, Mass.	Dallas, Texas	Gary, Ind.	Lexington, Ky.	New Orleans, La.	Rockford, Ill.	Spokane, Wash.	Wilmington, Del.
Brandon, Man.	Davenport, Iowa	Grand Forks, N. D.	Lincoln, Neb.	New York, N. Y.	Saginaw, Mich.	Springfield, Ill.	Winnipeg, Man.
Bronx, N. Y.	Dayton, Ohio	Grand Rapids, Mich.	Little Rock, Ark.	No. Battleford, Sask.	St. Cloud, Minn.	Springfield, Mass.	Winona, Minn.
Brooklyn, N. Y.	Denver, Colo.	Green Bay, Wis.	London, Ont.	Ogdenburg, N. Y.	St. John, N. B.	Springfield, Mo.	Winston-Salem, N. C.
Buffalo, N. Y.	Des Moines, Iowa	Greensboro, N. C.	Long Island City, N. Y.	Oklahoma City, Okla.	St. Johnsbury, Vt.	Springfield, Ohio	Yorkton, Sask.
Calgary, Alta.	Detroit, Mich.	Hamilton, Ont.	Los Angeles, Calif.	Omaha, Neb.	St. Joseph, Mo.	Syracuse, N. Y.	Youngstown, Ohio
	Dubuque, Iowa	Hamilton, Ont.	Louisville, Ky.	Ottawa, Ont.	St. Louis, Mo. (3)	Terre Haute, Ind.	
			Madison, Wis.	Parkersburg, W. Va.			



P and A

Charles Hazelius Sternberg

THERE is a striking romance in the career of a professional fossil hunter. His territory is the whole of the earth, his scope the whole of past geologic time and he must be a keen student of the record of the rocks. Mr. Sternberg, whose vivid account of a remarkable discovery appears on page 225, has been a fossil hunter since 1876 and is the oldest living member of his profession. He has worked under such famed scientists as Cope, Agassiz, and Marsh, great pioneers of paleontology, and his many collections may be seen in the United States National Museum, the American Museum of Natural History, the

British Museum, and at Cornell, Princeton, and Yale. He is the author of "The Life of a Fossil Hunter" and "Hunting Dinosaurs," and his home is in San Diego, California. Here we see him in typical field accoutrement at McKittrick, California, engaged in the infinitely painstaking task of revealing the skull of a fossil horse without injury to it. In some cases the fragments of fossils are so frail that only the expert, with years of experience and marked skill as well as patience, can work them out of the rock in restorable condition and transport them to a distant spot. At this work Mr. Sternberg is a past master.



Courtesy of Natural History

Ceremonial Dance at the Sacred Tree

A QUESTION which may well be asked is "what was the meaning of this curious procedure?" This is a very complicated anthropological question which is summed up briefly as follows: Most Australian tribes are divided into family groups, each group having a family totem. The words "totem" and "totemism" refer to widespread primitive religion with social as well as religious observances combined. Among the Australian tribesmen the totem is

usually an animal or a plant, and although not looked upon as a god, yet it holds a serious relation to every member of the group. With the belief goes a ritual which must be observed at a certain time of the year. What Dr. Wissler describes in the article beginning on the opposite page was the totem ritual of the group whose camp he visited. Not many white men have been permitted to see the sacred ceremonies of the Blacks of the western part of Australia.



All photographs courtesy Natural History

MAKING FIRE WITH A WOODEN FIRE DRILL

This native method of making fire is very crude, of by a bow as is done by savages more advanced in knowledge. Natives are in ceremonial dress for the drill is rotated between the palms instead

Among the "Blacks" of Western Australia

A White Man Visits One of Their Villages and Witnesses Their Odd Tribal Dances and Customs

By DR. CLARK WISSLER

Curator-in-Chief, Division of Anthropology, American Museum of Natural History

IN Australia the natives are called "Blacks," and most people seem to have the idea that the ways of the Australian native are decidedly "dark." At least everywhere we find him cited as the lowest of the low. Ask anyone where the lowest savages are to be found and the chances are that the answer will be "Australia." However, white people who live among these Blacks often come to have a high regard for them and rise to their defense when such statements are made.

IN 1925 the writer spent a few months in Australia, and, setting out from the city of Adelaide, made a quick trip westward to the edge of the open country, the present frontier of Australia. Today, as one travels west and north from Adelaide, the country grows rapidly dryer, and water becomes scarcer, soon bringing one to the great sandy plains, where roam tribes of Blacks who are still to see their first white man.

Our friends in Adelaide, knowing

that we were anxious to see the Black in his native country, had arranged, in advance, for a visit to a sheep station, or ranch, near Tarcoola, about 500 miles westward, from which it was possible to reach the localities where camps of Blacks were to be expected. The manager of the station, Mr. Mc-

Bride, welcomed us and did everything possible to make our visit pleasant and profitable.

Shortly after our arrival, in company with our host we set out in the two Fords to find a native camp which was said to be about 10 miles away. The sand was covered with scattered low clumps of blue bush, looking for all the world like sagebrush, with here and there a squat tree, called *mallee*—the "water tree" of the Blacks.



AUSTRALIAN WOMAN

These scarifications shown on the body are common among the native men and women

IN the course of an hour, dodging in and about between bushes and trees, and occasionally sticking in the loose sand, we came suddenly upon some natives running about and shouting. They were hastily putting on such old civilized clothing as they had in hand, because, not expecting white visitors, they were following their original habits. Nowadays, all natives are required to clothe themselves when in the presence of white people, so those who do approach the settlements keep at hand at least an excuse for a costume.



NATIVES DRESSED FOR VISITORS

The local missionary had supplied some of them with clothes. One woman became the camp aristocrat on account of her corduroy skirt



MAKING STRING FROM FUR

Before the rabbit was introduced into Australia the fur of native animals was used in the same way. Human hair is also used

We stepped out of our Fords into the midst of a camp of Blacks. The reception was friendly, and when a native employee of the ranch explained as best he could that we were Americans living far away, the leading men of the camp shook hands with us, making little speeches, the words of which were meaningless to us, but the kindly import of which was evident.

Whenever the Blacks make camp, they choose the side of a slight elevation or ridge; the reason is not far to seek. All serious ceremonies are for men only.

Women and children are not to see them or even to visit the place where they are held, so, as no one can see over the ridge from the camp, and the women and children are forbidden to go there, the sacred affairs of the tribe are safe from profanation. It is said that the usual punishment for spying upon the sacred ground is death. Such practices are common to all Australian natives and were known to us.

SCARCELY had we alighted in the camp, ere men began to approach over the top of this ridge. They were practically nude, but were decorated with paint and white down feathers. This, also, we knew to be the sign that a ceremony was in progress, and that was just the thing we longed to see. Not many white men have been permitted to see the sacred ceremonies of the Black.

Perhaps one reason why the Blacks are considered so low in the culture scale is their simple way of living. They build nothing in the way of houses, merely making a sort of low wind-break of brush in front of which a fire is built at night, for, as is the case in all dry countries, it is hot during the

day, but the nights are frequently cold.

The Blacks' fireside furnishings are almost nothing: a digging-stick and a rude wooden dish; for the man, a spear, a boomerang, a short club, and a stone flake or two to serve as a knife. These are the essentials. If to this we now add a few scraps of clothing, a tin can or two, a pipe and tobacco, we have listed all that white contact has added.

THE Black never stays long in one place and without notice may pick up his few belongings and trot off through the brush to a new camp. Nor are his food habits to our taste; when large game fails, which is the rule, he resorts to snakes and insects; then his cooking is little more than a gesture toward the fire. Water is too scarce to wash in, and his hair is never combed. I think most readers will agree that such a life as this is about as near the negative pole as can be.

Yet, your opinion of the Black will rise with acquaintance. He is happy, a good hunter, and above all knows how to live in the desert. Without canteen or water jar, he sets out boldly where a white would not dare follow. It is not

merely that he knows where the few water holes are to be found, but that he knows how to get water from the plants.

Every man in this camp had a long wooden spear; some of these had bone points, but usually the natural wood was merely shaped. These they can throw with force and skill, easily and at some distance killing a man or a kangaroo. Also, each carries in his belt a boomerang and a short club, for killing small game and birds. These they can throw with great precision.

There is much misinformation abroad concerning boomerangs, the general belief being that they return to the thrower; but the ordinary boomerang, the one used as a weapon, does not return; it revolves when thrown, and with such force that it can cut open a cheek or thigh if it strikes properly.

IT is a surprisingly effective weapon. Of course, some boomerangs do return; when we made it understood that we wished to see one, the whole camp was ransacked, only to produce two small, poorly made examples, not at all comparable to the handsome, efficient-looking boomerangs thrust under the belts of the men. To be returnable, the two halves, or blades, of the boomerang must be in slightly different planes.

So far as we could learn, those of the returnable type are used mainly as toys, because their movements are too uncertain to be depended upon to hit where they are aimed. However, in hunting water birds, they may be used to drive the flock toward the land and so within reach of the hunter, whereupon the birds are knocked down by the ordinary boomerang. One of the Blacks demonstrated with the returnable one; it sailed around somewhat erratically,



A CEREMONIAL TREE

On the trunk are mysterious symbols painted in red. Only those taking part know the meaning. Women are taboo

circling back, but not quite to the feet of the thrower.

Meanwhile preparations were being made for the sacred ceremonies to be held on the other side of the ridge. In the afternoon the men went to the ceremonial ground, giving us to understand that we could come later. After a time two old men came for us; we walked between them, abreast, while they beat two sticks together and sang songs; four times we paused for a few minutes, approaching the ceremonial place not directly, but circling clockwise. Here we found our friends standing in line around a tree, the trunk of which had been painted. As soon as we were in position, the ceremony proceeded; this consisted of dancing in a circle and finally rushing up to the tree. At the conclusion of the ceremony we returned to the camp, but not until the leader of the ceremony had laid upon us the injunction that none of their women should be told about what we saw.

THE natives were very anxious that we should stay for the festivities of the night—the "corroboree." Many writers speak of the "corroboree" as a sacred ceremony, but it is more in the nature of a social event. It takes place in the camp and all can join in, old and young. Before sunset we returned to the ranch house for a rest, and drove back to the camp after dark. As we neared the camp the Blacks waved burning branches to pilot us to the dancing ground. A space had been cleared of bushes and the roots grubbed up so as not to injure the feet. On the sides, brush had been piled, to be fired for tableau effects, for what good is a dance, if no one can see it?

Some old men, sitting in a row on one side, motioned me to a seat beside them on the sand. Most of the dancing was by women and girls; without clothing, their dark bodies painted with white lines, they danced in two files, holding their feet together and jumping up and down, in perfect unison, back and forth across the ground. The effect was barbaric but



A NATIVE HOME

The homes of the native Blacks are of a most primitive type of shelter built of brush

pleasing, and as a dance it was well executed. The old women and men sitting around, sang; while two men near me beat time upon the ground with their throwing clubs.

After the dance by the women, the men staged a few performances, one of which, representing the capture of an enemy, was especially successful. We greatly admired the way the evolutions were timed in the glare of lights when the piles of brush were lighted, and were sorry when the Blacks announced that the show was over.

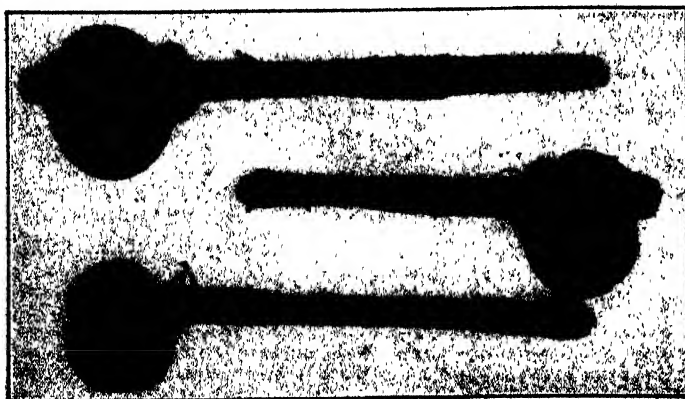
THE different races of man have individualities. Experienced travelers feel these distinctions, but always find it difficult to express them. Entering a village of African Negroes, such an experienced person would expect the little community to react to his presence in the characteristic African way; visiting the Eskimo, a different reaction would be expected, but to put these experiences into intelligible words is impossible, because they are matters of feeling rather than of logical analysis. One can, however, discuss one experience in terms of the

other. Thus, at first sight, the dark color and broad noses of the Blacks remind one of Negroes, but once in their camps the reaction of the group is not at all what one would expect from Negroes. Then, again, it is not like what one expects in a camp of American Indians, but the attitude of the Black is nearer that of the Indian than of the Negro. If, on the other hand, we compare the attitudes of all three with what we expect when entering a strange white community, then it seems that the Blacks are nearer to the whites than they are to the Negro or the Indian.

THE Australian head is narrow and long; the forehead is rather low and the brow ridges are bold and heavy, with the root of the nose deeply underset. The profile also shows the mouth thrust forward. Finally, the nose is broad and flat.

Comparative anatomists look upon certain of these traits as placing the Australian nearer the early ancestors of man than other living races. Nevertheless, the Australian is nearer the European type than the extinct forms of man, such as the Neanderthal, and in that sense is regarded as a modern type. If we reduce all this to a simple statement, its import will be that the Australian is a suggestion of what all men were at the beginning of the modern period, or to put it another way, in bodily and facial development he has not quite caught up with the other living races.

No evidence has come to hand indicating that any other people lived in Australia before the Blacks, while, on the other hand, there are indications that they entered the country a very long time ago and that no large amount of new blood ever reached the continent until the period of European settlement. So, for ages, the Blacks lived in relative isolation, untouched by the great culture changes and achievements in Europe and Asia. This may be one reason why they seem to us so barbaric and so crude, so reminiscent of what one conceives the Stone Age to have been.



STONE AXES

The men are armed with spears, boomerang and short clubs with stone heads attached as shown. The Black is very primitive in all things



STONE KNIVES

The native's fireside furnishings are almost nothing; a digging stick, a rude wooden dish, and stone flakes such as these to serve as knives

Our Point

The Public Will Be Confused

FIFTEEN enthusiastic men sailed northward in the *Italia*, under the gallant leadership of a man essentially without practical experience in the arctic. Of the deplorable losses which resulted the public already knows. Even experienced polar explorers lost their lives in the attempt to extricate the unhappy crew of the Italian airship.

The *Italia* was much too small for this undertaking. Her speed, 53 miles an hour, was also too low. Experienced arctic men warned the eager Italians of these facts. As a result of this misadventure, arctic navigation and exploration by means of the dirigible will inevitably suffer in the estimation of the public. Comparatively few will be likely to take the pains to differentiate the technical aspects of the matter. There will be a strong tendency simply to discredit the dirigible.

Plans have been matured by the "International Society for the Exploration of the Polar Regions by means of the Airship," generally known simply as "Aeroarctic," to explore the arctic next summer in the German dirigible *LZ 127*, under the leadership of the noted explorer Nansen. Dr. Nansen's practical experience in arctic life and travel is not limited to a flight across the top of the world, virtually as a passenger, on an air vessel which did not even touch the ice. The *LZ 127* is six times as large as the *Italia*—larger, even, than the *Los Angeles*. Her motors are powerful. Such a vessel will not be at the mercy of the rough environment of the north.

By no means let us permit the loss of the *Italia* to confuse us concerning the value of the dirigible in the arctic.

The Problem of Radio

FOR more than a year, the Federal Radio Commission has been contending with the stupendous task of untangling chaos in the ether, and attempting to bring peace and harmony to those whose business is to vibrate that all-pervading substance so that the general public may be provided with varied entertainment in their own homes. And, considering the obstacles to be overcome, and the total lack of precedent, they are, so far, making a creditable showing.

But the final radio Utopia is still far off. Even with the re-allocation of wavelengths, we still find that certain

local stations are invariably accompanied by a heterodyne whistle that makes reception a nerve-racking ordeal.

When reviewing the situation, it must be borne in mind that the available wave channels for broadcasting are limited. We cannot go above 600 meters—there are the commercial stations. Below 200 meters are the amateurs and special experimental

A Word to the Wise

WITHIN five years a community, large or small, without its own aviation field is likely to discover itself as much of a backwoods anomaly as a community would be now without a public garage. Every evidence points toward a sudden expansion of civil aviation, pivoting on the notable aviation year 1928 when civil aviation received a fresh impulse and took on a new scale of importance. We now have 5000 civil planes. There was a time when we thought 5000 automobiles a large number. Here is food for thought. What will be the corresponding figure next year; and the next; and the next? If the future may be judged by the past, airplanes will increase in geometric ratio and nobody knows at what rate. It will not be as high as the rate of automobile increase from the year 1900 on, but it will be high.

If these suggestions are true, what should a wide-awake small community do? One way to handle the matter would be to wait until the air is full of planes. Many communities will do that. A few, however, will take care of future needs before they arise, and with scientific care and system. Those communities which do this are more than likely to profit later on in more ways than they can think of at present.

stations. We must not infringe their rights, for the amateurs are in a large measure responsible for the radio development of today.

Considering all this, there seems to be only one solution, composed of several parts. Some of the present, least essential, stations must go. Many of the smaller ones are now considering mergers. In this way, a transmitter of greater power and refinement could be erected with the pooled resources of the various managements, and the station could then be used for certain hours of the day or days of the week by

each of the part-owners. Such a move on the part of several groups would at once alleviate present conditions, not only as to channel congestion, but also as to quality of programs.

Synchronization of wavelengths will also form part of the solution. By means of the quartz crystal or other method, stations in distant cities can operate on the same wavelength as a local, without any heterodyne interference.

The time is here when the American public demands, and rightfully, that they be given high-quality radio service. And the Radio Commission must produce more results. Their future actions will be watched with great interest.

Preserve Our Lumber Sources

ECHOING far and wide, a bitter controversy has raged for the past few months regarding timber cutting practice in the national forests. Accusations and recriminations have flown with the wind: "Land has been denuded of trees indiscriminately;" "No, only the most suitable trees are cut;" "Private cutters are heartless;" "No, the larger companies are replanting as fast as they cut." Thus the battle rages.

Now that the question is in the public mind, some result may be expected on this score, but little has yet been said regarding the practice, by farmers and small owners throughout the country, of cutting the trees on their lands for firewood and local lumber needs. These people should be made forest-conscious. Public sentiment should show them the inadvisability of cutting every stick they own, all in a single operation. They should be converted to selective cutting and the practice of replanting religiously. No forest, no matter how small, should be completely stripped, and, unless the land is to be cultivated, the new growth should be regularly thinned out so that a new forest will rise as quickly as possible.

Europe has suffered a scarcity of wood for centuries but she has managed always to have just enough firewood and lumber. This has been made possible only because there are rigid tree cutting and replanting laws in force. Will such legislation be the final end for us? It certainly promises to be unless we, as individuals and as a whole country, mend our ways and decide to give the forest monarchs a chance.

of View

Submarine Safety

SHORTLY after the S-4 disaster, SCIENTIFIC AMERICAN received a letter from a reader asking that we bring to the attention of the Navy Department a submarine salvage device he had invented. Numerous others were received also, but this particular one stated that a private citizen has no chance of being heard, that the Navy Department apparently relegated to the waste paper basket all such voluntary contributions sent in by individuals.

Why does such an opinion persist? The department officials do welcome ideas presented by anyone, and gladly consider, solely on the basis of merit, any that come to their attention. One does not need "pull;" nor must he have his over-worked congressman or a magazine such as this present his brain-child for him. His idea, device, or invention will receive full consideration if forwarded directly.

In June, Dr. W. R. Whitney was appointed chairman of a special naval board called together to study carefully the 4150 suggestions relative to submarine safety and salvage that have been received since the sinking of the S-4. All letters addressed to the Navy Department on these subjects will be referred to this board which will remain in session for an indeterminate time. This is the answer of the department to those who have often accused it unjustly.

Forward!

BLINDNESS! Is there anything that prompts our hearts to a more instant response than the vision of one bereft of sight? Is there anything more inspiring than the blind cheerfully and courageously carrying on in their daily life, which often is a business life as well?

Twenty years of sympathetic, well organized, and directed effort has reduced blindness caused by ophthalmia neonatorum or "babies' sore eyes" among those admitted to schools for the blind, until it is now 64 percent less than in 1908. What a fine accomplishment for such bodies as the National Society for the Prevention of Blindness.

Great advance has also been made in sight-saving classes, pre-school eye testing and educational travel in the United States, Canada, and Great Britain, by devoted men and women spreading the gospel of sight-saving.

Eye hazards in industrial occupations, constituting one of the most serious causes of blindness, (15 percent of the 100,000 blind in America) has also received special attention.

Much has been done, much is yet to be done, but what a gage of inspiration for future effort is the safeguarding of the eyes of the next generation, and the preservation of partial sight among those bereft of full vision! All honor to the late Dr. Hideyo Noguchi and his fellow workers; and, lest we be guilty of empty words, let our support of this consistent and organized effort

No Billboards

THE Supreme Court of the state of Kansas has declared valid a statute enacted by the state legislature which prohibits any kind of signs, except official markers, on the right-of-way of any highway. It also prohibits the erection of any kind of advertising sign within 500 feet of a turn in the road, an intersection, or a railroad crossing.

A great deal has been said regarding this national nuisance and volumes more could be written, for the subject is one of disgustingly large proportions. We do not wish to discuss it, however, but to commend highly the state of Kansas for taking the leadership in this worthy campaign. Other states should take notice.

be a tangible one to swell the coffers to carry forward a magnificent work.

Valuable Marshes

DRAINING of marsh lands may not always be productive of good results, is the opinion of A. A. Saunders who has just published a study on the Montezuma swamp regions for the Roosevelt Wild Life Forest Experiment Station at the New York State College of Forestry, Syracuse University. On the contrary, swamp lands or marshes, drained so that the land may be used for agricultural purposes, often turn out to be worthless.

Such low lands may be the breeding places of valuable game and fur-bearing animals. Deprived of their natural homes, these animals may either die out or migrate to more favorable localities. Draining may also result in the lowering of water tables near the heads of streams, resulting in the drying up of springs and wells. Such a

condition would add greatly to the forest fire menace and might tend to make adjacent lands less productive agriculturally. It is possible, too, that the seeping away of underground sources of water would cause an increase in temperature of surface streams to such a degree that they would be no longer habitable for fish.

While it is true that such conditions may be found in large measure in draining large areas only, there is danger that some of them may result from injudicious attempts to reclaim small marshes. In any case, natural conditions should not be disturbed until after the situation has been carefully studied from many angles.

Stop the Waste

ENORMOUS waste in industry results from the present practice of producing essential commodities in an arbitrary and haphazard array of sizes, models, and qualities. Often an article is manufactured in dozens or hundreds of sizes when only a relative few are necessary. The result is that the cost of production, which the consumer ultimately pays, is greatly increased, and the consumer is often uncertain that he gets just what he wants.

Arguing that the purchaser may buy an ounce or two ounces of a drug at a drug store but, rather than ask for 16½ or 17 ounces, would purchase a pound, a pound and a half, or two pounds, the American Engineering Standards Committee has tackled the problem of weeding out the unnecessary sizes. The committee would substitute a "preferred numbers" system in which, as sizes increase, the progression is in greater jumps on a regular percentage basis. It is said that the new system can be applied with a saving to almost every commodity from bread to machinery and from handbags to packing cases. The committee is also looking into the question of qualities and models with the purpose in mind of standardizing these so that purchasers may know exactly what they buy.

The committee's work as a whole is to be commended and its promotion of the "preferred numbers" system should have the support of every far-sighted person. One very great advantage that would result from the nation-wide adoption of this system would be the increase of the degree of interchangeability of goods manufactured in different parts of the country.



P and A

FRENCH SCIENTISTS HONORED

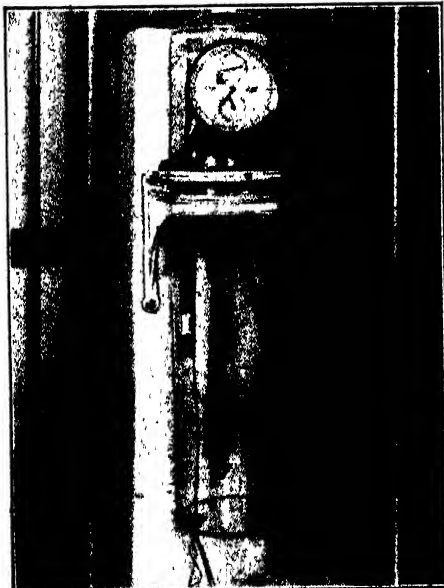
Dr. Negre (left) and Dr. Boquet, chiefs of the Pasteur Institute Laboratories, Paris, to whom the B. J. Rosenthal Prize of 25,000 francs and a gold medal was awarded for their work in tuberculosis research during 1927



P and A

SCREEN-TESTING THE VOICE

Pres. R. B. von Kleinsmid of the University of Southern California supervising a screen-test of the voice of Anita Page for "talking movies." The telegraphophone shown here is being used in a series of such tests



P and A

THE TIME OF THE NATION

One of three clocks kept by the Naval Observatory in an underground, constant-temperature vault in Washington. A transmitting clock, set from one of these each day, sends out time signals. Air is partially exhausted from the sealed glass cases of these clocks, and the vault temperature is maintained at 84 degrees, Fahrenheit

From the Scrap-book of Science



Courtesy Field Museum of Natural History

OLDEST KNOWN WHEELS

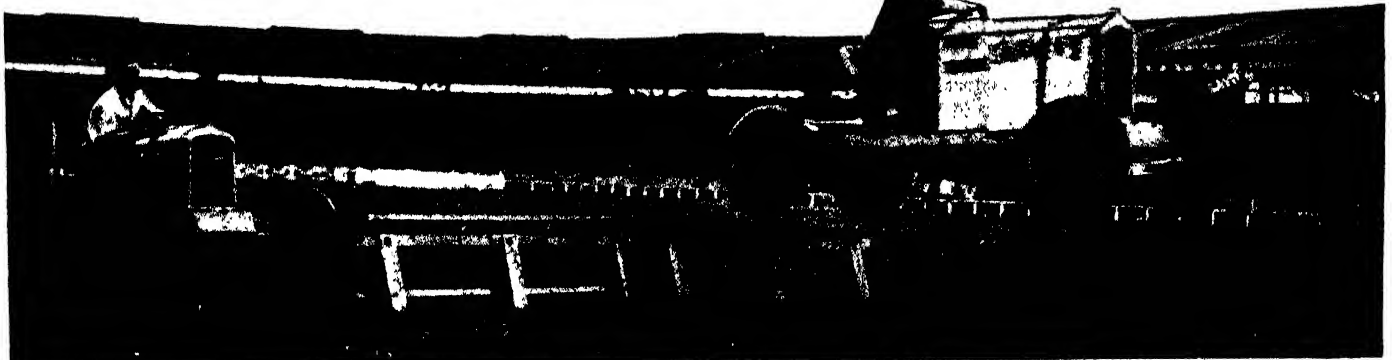
The Field Museum-Oxford University Joint Expedition unearthed these 5000-year-old chariot wheels at Kish. Apparently they were flattened by weight of the earth over them. The expedition has unearthed two four-wheeled chariots, and one two-wheeled one, all ancient



P and A

LARGEST U. S. TUNNEL

President Coolidge recently touched a button that set off the last blast that completed the Cascade Tunnel of the Great Northern, through the Cascade Mountains. It is eight miles long and will shorten the transcontinental trip by 50 miles. The photograph shows the lining machine which follows each blast and lines the bore as fast as it is made

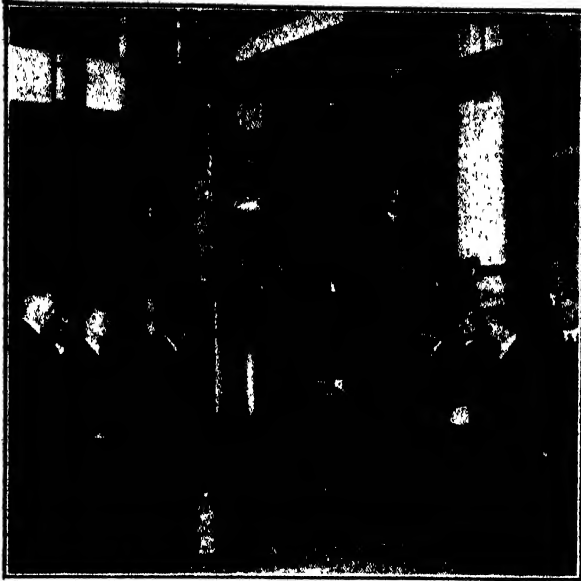


P and A

TAKING THE HURDLES IN HIGH

Not to be outdone by the airplane, the automobile now takes to the air. André Mercier, famous French auto-

mobile dare-devil, is shown just after a take-off from an incline in a car rated by the French at five horsepower



Underwood and Underwood

10,000,000 POUNDS COMPRESSION

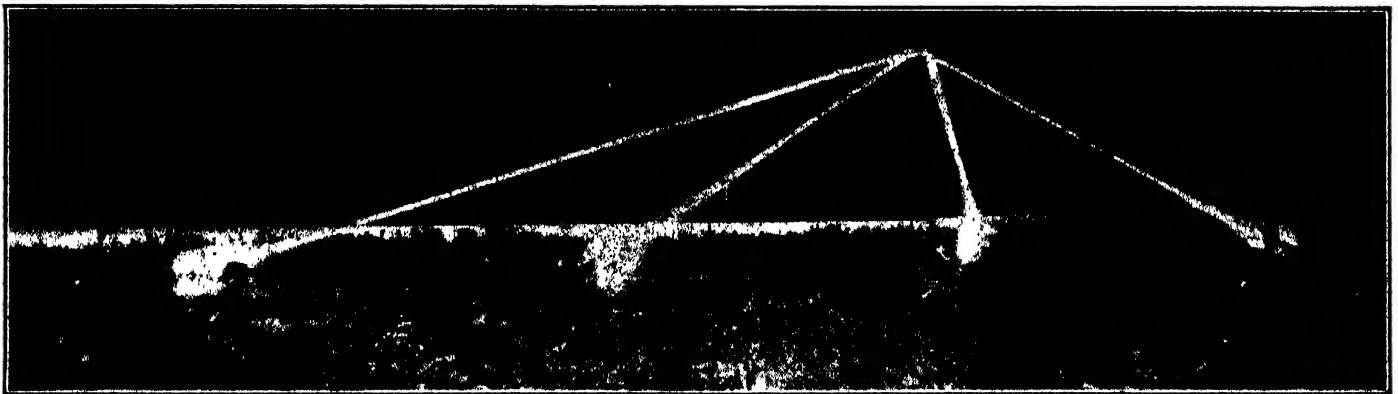
H. L. Whittemore explaining to a group of visiting New York skyscraper men how the Bureau of Standards tests building materials. Above: a 10,000,000-pound compression machine



Acme

FOR IRRIGATION AND POWER

The newly-completed Horse Mesa Dam in Arizona, 305 feet high and 784 feet across its crest, impounds the Salt River to supply water for irrigation and to generate 40,300 horsepower at the toy-like power plant at its foot. This dam is 65 miles east of Phoenix

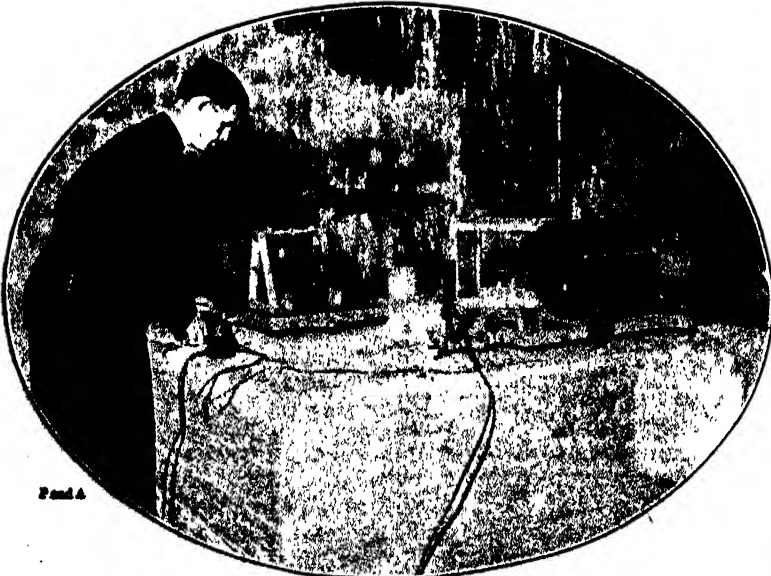


Past A

TRACER BULLETS AGAINST A DARKENED SKY

Spectacular night "warfare" recently conducted by R. O. T. C. cadets at the University of Missouri. This unique

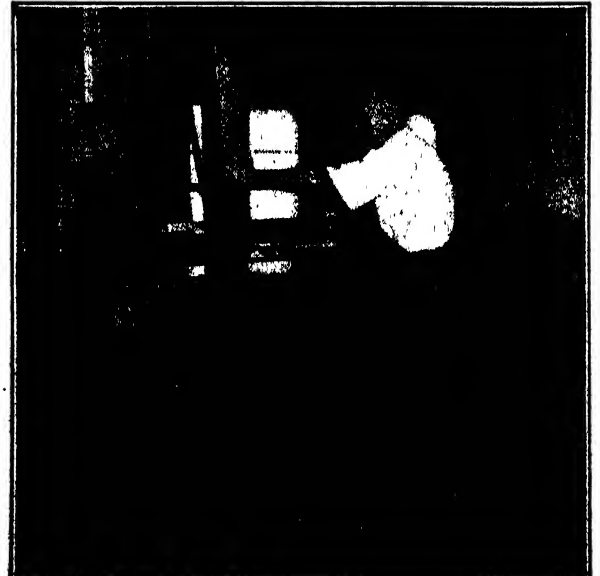
time-exposure photograph shows tracer bullets from machine guns converging to a point on a distant target



Past A

CATCHING AN EARTHQUAKE A DAY

With the three new Willip Galitzin seismographs imported from Esthonia and now installed at Fordham University, New York, Father John Tynan expects to record at least one earthquake a day where formerly he caught an average of 10 or 12 a month



Courtesy Field Museum of Natural History

"MAGIC" WOOD

One of only two specimens in the world, this bloodwood cacique log has been placed on exhibition in the Field Museum. The Indians of Panama attribute magic powers to the wood

Three Centuries of Natural Philosophy*

Although Science Has Apparently "Come of Age," Only the Short-Sighted Dare Predict That It Has Passed Its Vigor

By W. F. G. SWANN, D.Sc.

Director, Bartol Research Foundation of The Franklin Institute

(Concluded from August issue)

THIRTY years ago was a time of great depression in physics—a time when would-be Ph.D.'s went about like roaring lions seeking something to measure and finding nothing but the density of a gas or the viscosity of a solid. The sentiment of the times was well voiced by a certain European physicist of eminence who stated that it was probable that all the important experimental discoveries in physics had then been made and that henceforth the investigator must confine himself to a repetition of what had been already done with greater attention to minor matters of precision.

EVEN in those days the apparatus cases of most laboratories contained curiously shaped glass tubes containing rarefied gases of various kinds which could be made to glow in fantastic manner by sending an electric discharge through them. Few sought to penetrate the mysteries of those tubes. They would be brought forth on the occasion of popular exhibits in the laboratory, made to go through their alluring performances and then returned to their cases to await the next festivity of the kind. They were not viewed as serious articles of scientific research, but were considered as hardly more than toys.

And yet, what a marvelous secret they held! For it was in one of those tubes that, in 1898, J. J. Thomson discovered one of the two fundamental bricks out of which the universe is built—the electron—the tireless worker whose home is in the atom—the thing whose quivers send us light from the sun, whose ceaseless flight around the atom's center gives the magnet the power to pull—the thing whose motion through the electric cable constitutes the electric current—the thing whose splash when hurled into the atom with great

speed is the X ray—the thing whose motions in the antenna send us wireless waves, and whose motions in the radio tube enable us to detect those waves.

It is to the electrons that matter owes all its chemical properties. It is electrons from the sun which are responsible for the aurora. The atoms of which matter is composed are so small that about a hundred million of them laid in line would take up but the length of one third of an inch, but the electron is so small that even in comparison

in penetrating nature's mysteries when we were able to say that, on the basis of certain plausible considerations, it was probable that if a drop of water were magnified to the size of the earth, the molecules would become as large as small shot. The discovery of the electron gave a fresh impetus to man's hope of understanding the atom, and before long the second fundamental brick of nature's structure revealed itself—the fundamental unit of positive electricity—the proton, whose natural home is in the nucleus, the heart of the atom. The proton is 2000 times as heavy as the electron but it is 2000 times as small, so that if the proton were magnified to the size of a pinhead, that pinhead would, on the same scale of magnification, attain a diameter equal to the diameter of the earth's orbit around the sun.

AT the end of the last century Roentgen discovered X rays. The property by which they first claimed attention was their power to pass through flesh and so show shadows of the bones of the body. Soon, however, it was realized they were endowed with many other properties of a most important and interesting kind, properties which were bound up with the atom's structure and whose study therefore served to throw further light upon that structure.

Until the end of the last century, one of the most firmly established beliefs was that of the permanence of the atoms. However, near its close, Becquerel found certain curious properties of uranium oxide which suggested that this substance was continually emitting some kind of a radiation which could pass through screens opaque to light, and affect a photographic plate. Several other substances were discovered possessing this property, and many other characteristics of these substances were discovered, characteristics which could only be harmonized on the belief that the atoms of these substances were in a continual state of spontaneous dis-



Courtesy General Electric Company

X-RAY DIFFRACTION APPARATUS

The modern form of the apparatus for studying by means of X rays the atomic structure of matter, as mentioned in the text. Most substances prove to be crystalline

with the atom it is but as a fly compared with a cathedral. It is so light that if everything were magnified in mass so that the electron attained a mass of four ounces, that four ounces would, on the same scale of magnification, become as heavy as the earth.

Before the discovery of electrons we had cause to believe that there were such things as atoms and molecules, but nobody ventured to picture their structure, and we felt we had gone far

*Founders Day Address, Swarthmore College. From *Journal of The Franklin Institute*

integration—of atomic explosions if you will, and that the phenomena observed were the symbols of these explosions.

One may naturally be led to inquire how far discoveries in pure physics and mathematics find their reflections in the things of everyday life in the sense which we call useful. If in a great city we should set out on our travels with the intention of visiting all the places within the field of our immediate interests to the exclusion of others, and if we should refuse to walk along any street which did not itself contain many of these places, then, even as regards those things to which our interest was confined, we should limit greatly the possibilities which that city opened to us. If this is true of a relatively simple structure like a city, how much more is it true of that beautiful framework of science whose parts are so clearly interwoven that it is almost impossible to touch one of them without producing response in all the others.

WHILE, therefore, the man of science must pursue knowledge for its own sake, it is a remarkable fact that practically all of those achievements in the physics of the past 20 years which might be classed as utilitarian, have arisen directly from, or in relation to investigations pursued with no utilitarian motive directly in view. X rays revealed themselves first in the light of their importance in surgery. The study of their properties shed a new light upon the structure of the atom and this light was reflected back with enhanced intensity to clarify the properties of the X rays themselves.

The immediate application to photographic surgery was obvious, but that field which is concerned with the effects of the rays upon the body tissue, upon the cure of cancer and the like, was not so evident. Bound up as it is with the properties of the rays in relation to their passage through matter, with their absorption in the tissues, and the extent of the molecular disruption

which they produce, it must draw for its development upon the more fine-grained aspects of the study of X rays which the physicist has made in the field of his own interests.

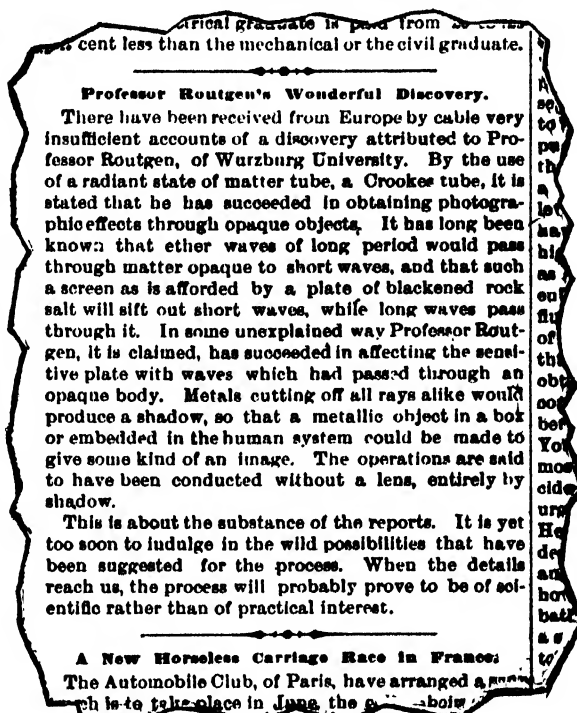
The study of radio-activity has taught us that in the spontaneous disintegration of the atoms which accompanies this process, powerful radiations are emitted. First we have the alpha particle, a positively charged atom of helium, with a velocity of 18 miles per second. Then we have electrons traveling with a velocity 10 times as large and finally we have a very hard type of X ray known as gamma rays. These rays possess the power to disrupt molecules through which they pass and it is this power which gives them, in common with X rays, such great value in medicine. The surgeon's knife can dissect the tissues and remove the larger malformations of growth, but the X rays, the rays from radium, and those of ultraviolet light can dissect the malformation on things 10,000 times smaller than the smallest things which our microscope can reveal.

The detailed investigations of phenomena pertaining to the passage of electricity through gases—phenomena whose study led to the discovery of the electron, necessitated an improvement in our methods of producing high vacua.

THE pumps of today can accomplish in 15 seconds what would have taken a couple of hours 25 years ago, and the vacua attainable are 20,000 or more times better than they were in those days. We can now reduce the pressure in our apparatus by means of modern pumps to such an extent that only one in every hundred thousand million of the molecules originally present remains.

This improvement in the technique of producing high vacua, rendered necessary for investigation in pure science, has rendered possible the electric lamps which we use today. It has rendered possible the modern X-ray tube—an instrument not only infinitely more reliable than the weak and capricious tubes of 20 years ago, but controllable in intensity to amounts 20 times as great as those formerly attainable. It is only through the aid of modern vacuum technique that the modern broadcasting station has been rendered possible, that the radio amplifying tube has become a reality, and that we can have wireless transmission of signals, speech, and photographs.

If, 20 years ago we had wished to give an example of a type of research which was least likely to have an utilitarian value, we could hardly have chosen a more fitting example than the investigations which Professor O.



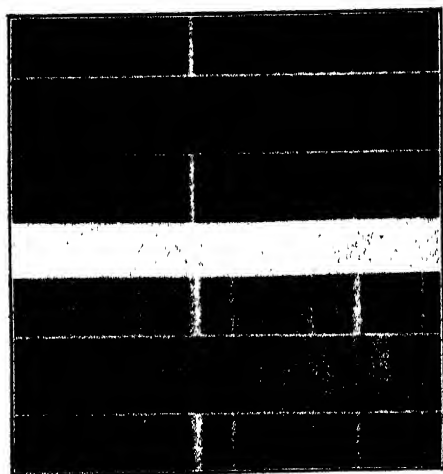
"WILD POSSIBILITIES"

This little note is reproduced from the SCIENTIFIC AMERICAN, January 25, 1896. It contains evidence that Röntgen's name was not yet widely known to the world

W. Richardson had been carrying on in England, and later at Princeton, on the emission of electrons from heated wires; yet it is to these investigations, combined with the power to produce high vacua, that we owe the modern radio tube, the X-ray tube, and a variety of appliances used in the general fields of radio transmission and X-ray technique.

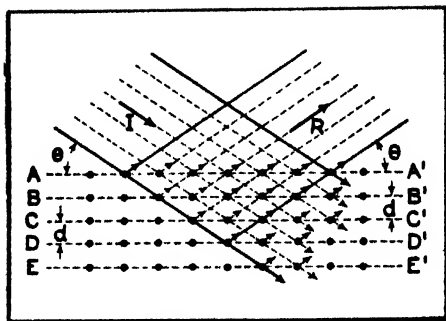
It has long been known that light when falling upon the surface of certain substances possesses the power to eject electrons from them, and the study of this phenomenon has been one of primary importance in relation to our knowledge of atomic processes. But it, too, has had its practical application, for it is this phenomenon which has rendered possible the wireless transmission of pictures, and a variety of other things hardly less important even though less spectacular.

MANY years ago, Rowland, of Johns Hopkins University, showed us how to rule very fine, closely spaced parallel lines on speculum metal and use them to analyze light into its component colors. That which the grating does to the light can be predicted if we know the spacing of the lines; and, conversely, if we had known beforehand the nature of the light, we could have gained information regarding the spacing of the lines. Since



COMPARISON SPECTRUM

The motion of the star is shown by side-wise displacement of the middle bands



X-RAY DIFFRACTION THEORY

Incident beam I is reflected at a definite angle. Beams from successive atom layers reinforce one another if in like phase. The wavelength being known, the atomic spacing may be calculated from the angle of reflection

X rays are of the same general nature as light, but of much shorter wavelength, it became a matter of interest to inquire how far such methods could be applied to them. It soon appeared, however, that for the successful pursuit of this problem, it would be necessary to rule lines whose distance apart was of the order of one-hundred-millionth of a centimeter.

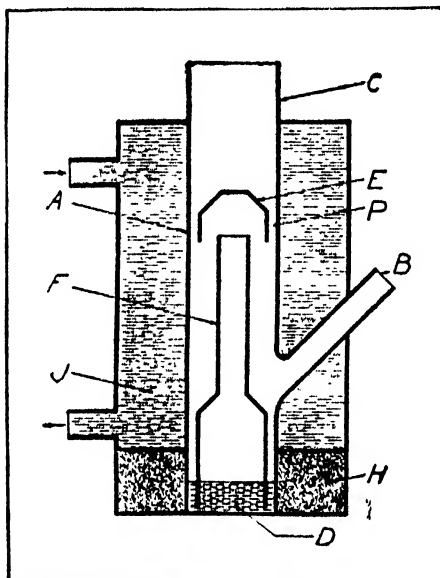
We cannot, of course, make such ruling, but nature has provided us with something very like them in the regularly spaced atoms which constitute a crystal of rock salt, for example. About 15 years ago, Laue found that he could make a crystal act in relation to X rays in very much the same way as Rowland's gratings acted toward light. The matter was pushed rapidly forward by a number of physicists, and soon gave accurate means of measuring the form of distribution and spacing of the very molecules of the crystals.

IT is quite impossible in a short space to give any idea of the tremendous field of activity which these discoveries opened up in relation to atomic structure on the one hand, and the nature of X rays on the other. Not only this, but it soon became realized that there were other fields of usefulness for the new method. Not the least among these has been its application to the structure of metals, which has provided the metallurgical engineer with a new method of attack in the detailed examination of his alloys, and of the effect of strain and other treatment upon them. Whereas formerly the limits to the fineness of his examination were determined by what his microscope could see, he is now almost in a position to look at the very molecules themselves.

Many years ago, Professor Michelson, of the University of Chicago, became interested in the question of whether or not the velocity of light is affected by the earth's motion. This is an experiment having, at first sight, nothing but a philosophical interest. But Professor Michelson obtained an unexpected result, a result which did not harmonize with our understanding

of nature's laws; and herein lay its great value, for it showed that our modes of thought required revision. This great revision, not, of course, in the laws themselves, but in the sense in which we interpret them if they are to harmonize throughout, constitutes the theory of relativity—a way of looking at things which soon made its influence felt outside of the domain in which it was born—a scheme of thought which has enabled us to see harmony in, and so understand, many wonderful things in the theory of electricity, atomic structure, and other branches of physics.

Moreover, here again we meet with a remarkable example of the interdependence of the various parts of science on each other. Of all branches of pure mathematics one could hardly conceive any farther removed from nature than those having to do with non-euclidean geometry, and the so-called



Courtesy James G. Biddle

HIGH VACUUM PUMP

With no moving parts, the Langmuir mercury vapor pump creates a vacuum of one 10,000 millionth atmosphere. Mercury is boiled at D, passes through F and strikes cooled wall A. Gas enters C, is drawn into vapor blast at P and exhausts at B.

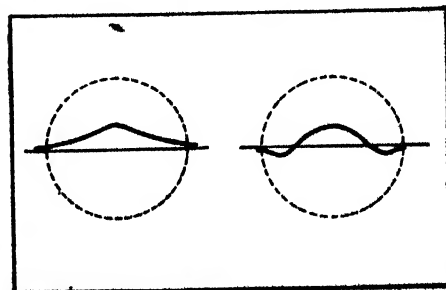
absolute calculus of Ricci and Levi-Civita. These were fields so specialized as to be studied only to a very limited extent by mathematicians themselves. Yet, even as an archeologist might suddenly come upon a scroll of papyrus outlining the laws of an ancient civilization, and might therein find the means to harmonize and understand the other visual records which his search had unearthed, so Einstein found in these abstruse writings of the mathematicians the wherewithal to express the unity of nature's laws in a form so beautiful that he has likened that expression to a wonderful symphony of which our universe is the expression of God's rendering.

Astronomy, the most ancient of the sciences, has always occupied a place in the forefront of the imagination of

the scientist and the layman alike. With the motions of the planets coordinated by Kepler, and moulded into a beautiful scheme of physical law by Newton 300 years ago, there seemed but little more that man could expect to discover. The growth of the science of optics soon provided a tool whereby to explore farther, however. Laboratory studies of the nature of the light emitted by incandescent solids and gases soon provided a means of determining much concerning the heavenly bodies by a study of the light which they emit. Stars which are so far away that their light, traveling towards us at the rate of 186,000 miles per second, takes thousands of years to reach us, may move with great velocity without that velocity making itself apparent by direct observation. A study of their light has enabled us to determine their speed in very much the same way that we could determine the speed of a train by noting how much the pitch of its whistle is altered by the motion.

THE stars are so far away that even in our most powerful telescopes they appear but as points in spite of their great size; but by drawing in greater detail upon our knowledge of the way in which light comes to us and of the effect of the size of the emitting body on the character of the light, Professor Michelson, at an age when most men are content to rest upon their laurels, performed one of the most brilliant feats of a lifetime of masterly achievements in measuring the diameter of one of these stars, a feat equivalent to measuring the diameter of a penny at a distance of a thousand miles.

Strange as it may seem that we can learn so much about the stars which are so far away, the last few years has enhanced still further the wonder of it all. For the knowledge which we have gained about matter by experiment in the laboratory has found a most remarkable field of application in enabling us to understand the conditions which must prevail in the stars; and, these stars by their peculiar characteristics of large size, high temperature, high density, and so forth, have pro-



Redrawn from the Scientific Monthly

THE NEW ATOM CONCEPT

A purely imaginary, diagrammatic effort to convey a rough idea of the de Broglie-Schrödinger atom. The sphere varies in density perhaps as shown. The new atom concept involves both particles and waves

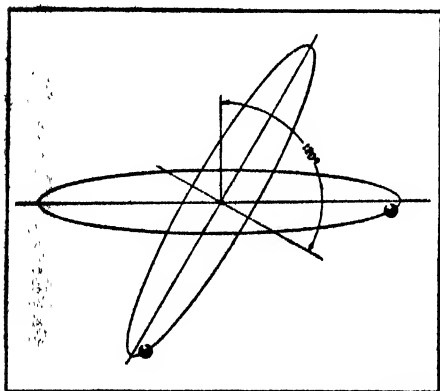
vided us with conditions to test our conclusions such as we could never have hoped to attain in the laboratory.

A gas compressed to a density 8000 times that of steel is but a figment of the imagination in the laboratory, yet of such stuff is the Companion of Sirius made. Temperatures of 40 million degrees correspond to things 10,000 times as hot as any temperatures we find on earth, yet nature has realized such temperatures in some of the stars. And so the stars, far from being things through which we dare hope to learn but little, have, by their exceptional condition, served to provide us not only with a very fascinating story of their own life history, but with a large part of the story of the birth of matter itself.

Discoveries in the fields of experimental science naturally go hand in hand with that study of the laws of design of the universe which we call theoretical science.

One supplements the other, and the strength of one enhances the strength of the other. It is naturally around the atom's structure that the thoughts of men have loved to hover. And here, the power to comprehend a new point of view has grown enormously in the last few years. We have a clearer understanding of what understanding means.

WE were in danger of becoming so enamoured of those laws which govern the behavior of matter in bulk as to refuse to admit any other possibilities in respect to the laws of the atom. The workings of the coarse-grained things of nature were all about us. Pulleys, springs, water torrents, the waves of the sea, these were things of common



MODEL OF HELIUM ATOM.

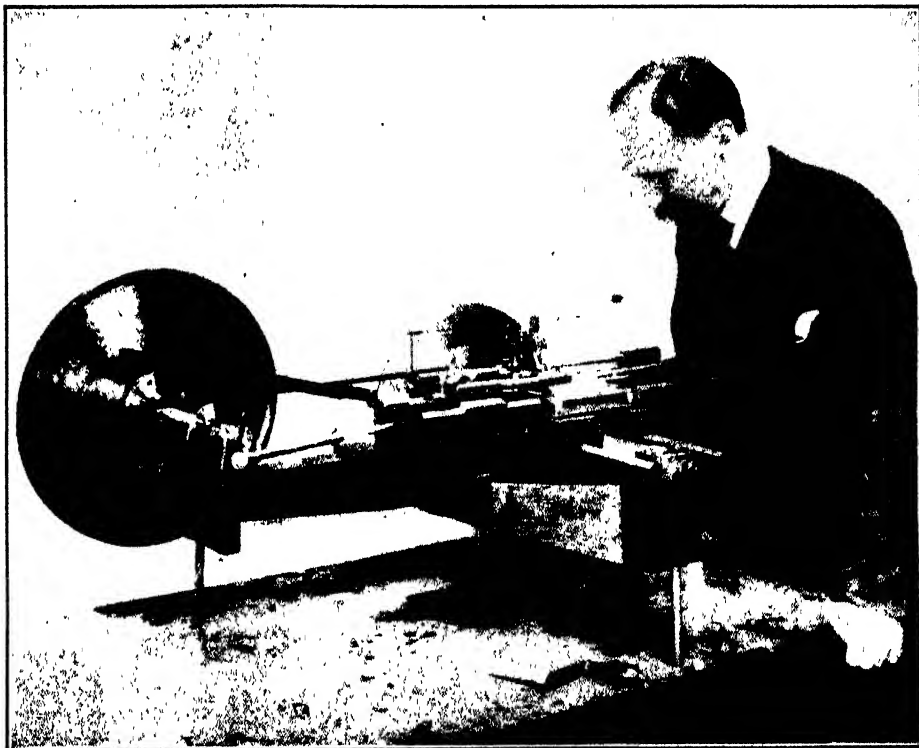
Kemble-Bohr model of an atom of helium, magnified about a thousand million diameters

experience, and the mind sought contentment in the thought that the atom might utilize in its structure only things which behaved as these things behaved; and even as a little hill may hide the Alps from one whose life is in its shadow, so there was danger in the known and obvious workings of the common things around us obscuring from our vision the story of that great

universe of the atom which lies beyond.

Happily, the complacency of our outlook has received, in recent years, one or two serious jolts. First came the theory of relativity, which taught us that a greater elasticity of thought was necessary if we were to understand nature as she is rather than as we might have made her. Then came a series of

theory as right and all the others wrong. In a sense, different theories are like different languages for describing the same phenomena. The English language may be more suitable—more powerful for the purposes of the science of chemistry than the French language. It may have a greater richness of word content; but to say that



Courtesy Johns Hopkins University

PROFESSOR ROWLAND AND HIS RULING ENGINE

This extremely refined mechanism rules diffraction gratings with a diamond point, putting six miles of minute parallel lines on a five-inch circle in 63 hours. Such a grating gives more accurate spectra than prisms, because errors due to the intervention of glass are eliminated

experimental phenomena which seemed to violate all our notions of how things should be, and since we could not alter the experimental phenomena we had to alter the notions, and so there arose the so-called quantum theory of atomic structure—one of the most helpful crystallizations of thought for correlating the facts that we have ever had.

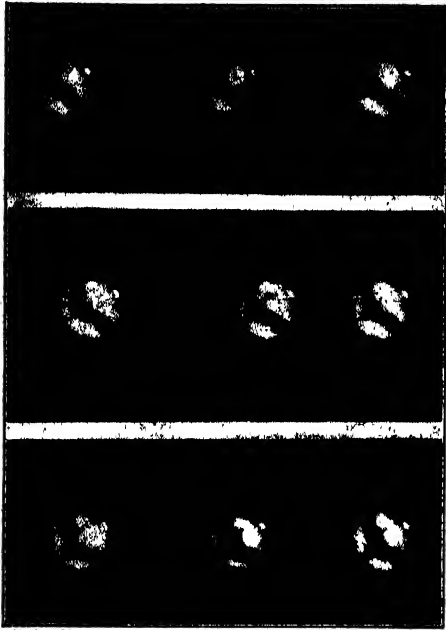
And then, as further search showed this theory to be inadequate beyond a certain stage, there arose only a couple of years ago, an entirely new way of regarding the atom—a way so radical in its point of view that it is safe to say that had it been put forward fifteen years ago, it would hardly have attained a hearing. Born in a day of more liberal thought, however, it had no sooner made an appearance than a host of workers arose to welcome it and to develop its consequences, so that today there is hardly a physical laboratory in the country which does not contain one or more people who have acquired the power to think in its terms.

In speaking of theories being discarded and superseded by others, we must not think of the discarded ones as useless. The situation is not so much one where we are to think of a certain

one is right and the other wrong is to utter nonsense.

And so, a quarter of a century after the prediction of the eminent European philosopher to the effect that discovery was ended we find ourselves in the most intensive period of scientific activity of all time. We may well ask where we are headed. Shall we continue to discover new treasures, or, when we have catalogued those we have, shall we reach again one of those periods of stagnation? If we do, and if there be any one who then feels that progress is ended, that knowledge is complete—and that science is dead, let him think of how confidently he could have voiced that same thought in the civilization of the Pharaohs. Let him think with what surety he would have voiced it in the years which followed Newton. Let him think how he would have voiced it—yes, perhaps how he did voice it 30 years ago, and then let him take hope.

For the words of the Bard of Avon are truthful yet. There is more in heaven and earth than is dreamed of in even twentieth century philosophy, and the richness of nature's content will not be fathomed in our time.



MARS IN ROTATION

The astronomer generally makes several exposures on the same plate. Here the three plates were exposed at 60 and 22 minute intervals, respectively

THERE are some advantages from the standpoint of scientific meetings in living in a country of less than continental size. People can get together oftener. The National Academy of Sciences, for example, meets twice a year—once in Washington and once in some university town. The Royal Society meets every week, except in the summer.

One result of this is that on special occasions when visitors from abroad are present in numbers, the sessions of English learned societies are sometimes turned over almost entirely to their guests. For example, at the meeting of the Royal Astronomical Society a few days ago, every speaker came from overseas, our English colleagues generously foregoing the chance to present their own work which was left to be "read by title" and published later.

THE principal event of the day was the George Darwin lecture which was given by Professor W. H. Wright of the Lick Observatory. Some of the admirable photographs of the planets which he exhibited are already familiar to American astronomers, but the most noteworthy of them were altogether new.

We are familiar with the "speeded up" moving pictures which show, for example, the opening of a flower before our eyes, but no one before Professor Wright has had the audacity to think of moving pictures of the rotation of a planet. Jupiter, which completes a rotation in a little less than 10 hours, was chosen for this bold attempt. Only in such a climate as that of California could there be any chance of success,

Animating Jupiter

For the First Time Direct Motion Pictures of a Rotating Planet Have Been Made— Astronomical Correspondence from England

By HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mt. Wilson Observatory of the Carnegie Institution of Washington

for photographs must be taken at regular intervals of a minute or two all night long—or at least so long as the planet is high enough in the sky to observe satisfactorily. Even so, no single night's work suffices to follow a whole rotation, and two or three successive nights are required before every aspect of the planet has been recorded.

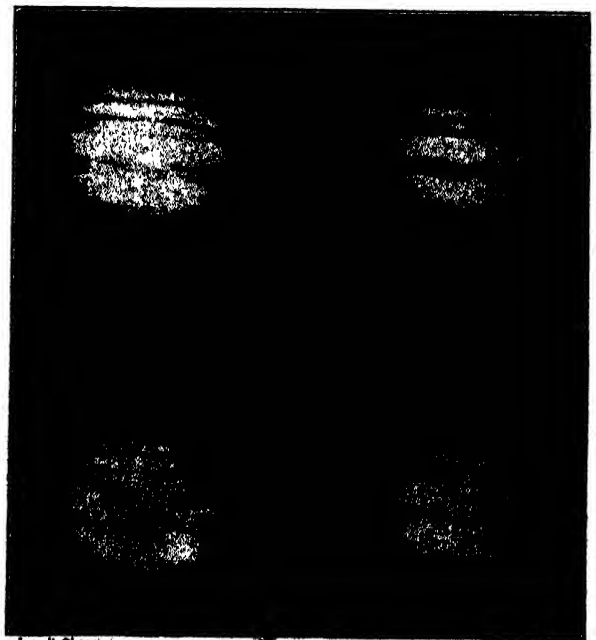
Extraordinary care and eternal vigilance must be exerted to see that the planet's images are all in correct register so that the final image on the screen does not oscillate, but this problem like others has been solved, thanks to the co-operation of Professor Wright and Dr. Mees of the Research Laboratory of the Eastman Kodak Company.

A CAPACITY audience in the historic rooms of the Royal Astronomical Society watched the first showing of the films and broke into the heartiest applause. The diversified surface of the planet was shown in clearest detail and the steady rotation showed itself so simply and naturally that it was hard to realize what pains and labor had gone to speeding it up a thousand times until it became conspicuous to the eye. The Great Red Spot and the smaller details of the surface passed in stately procession across it. At one point in the revolution a satellite appeared at the side of the screen and advanced rapidly toward Jupiter. Just before it reached the planet the shadow of the satellite entered upon the disk, followed a moment later by the satellite itself which in contrast to the black shadow appeared as a pale greyish spot.

These pictures form the most remarkable presentation of the actual progress of stellar motions which has ever been shown. When and how they may become available to a larger public, the writer of these lines does not

know. It is greatly to be hoped that they may be widely exhibited and, if they are, that all who are interested in the heavens will take the opportunity to see them.

At the same meeting Dr. H. Spencer Jones, who is Royal Astronomer at the Cape of Good Hope, gave an interesting account of the latest observations of Nova Pictoris. The rings which have been reported as seen about the star's image on certain photographs appear to be of instrumental origin, for different telescopes show them of quite different sizes. They probably arise from the peculiar character of the star's spectrum which is rich in bright lines.



JUPITER (NOT ROTATING)

The hazy edge of the photographs is due to the planet's dense atmosphere. Jupiter rotates in 9 hours, 55 minutes

If the light of some of their wavelengths is not brought by the lens to exactly the same focus as the rest, the observations are explicable. With powerful visual telescopes, however, the nova itself has appeared double and more recently triple; in fact a fourth very faint component has been suspected. All these objects appear as condensations in a small oval patch of light and the whole affair is so small—

less than a second of arc across—that only a large telescope will resolve the details at all, and that under the best seeing conditions alone.

What these extraordinary observations mean, no one dares to suggest. It is not yet certain whether some unusual optical disturbance of the image may not be at work, and any attempts at theorizing or at talking of a star "breaking up into parts" do not find favor with the judicious. It is clear, however, that we have here to do with one of the most interesting novae upon record and future developments will be awaited with great interest.

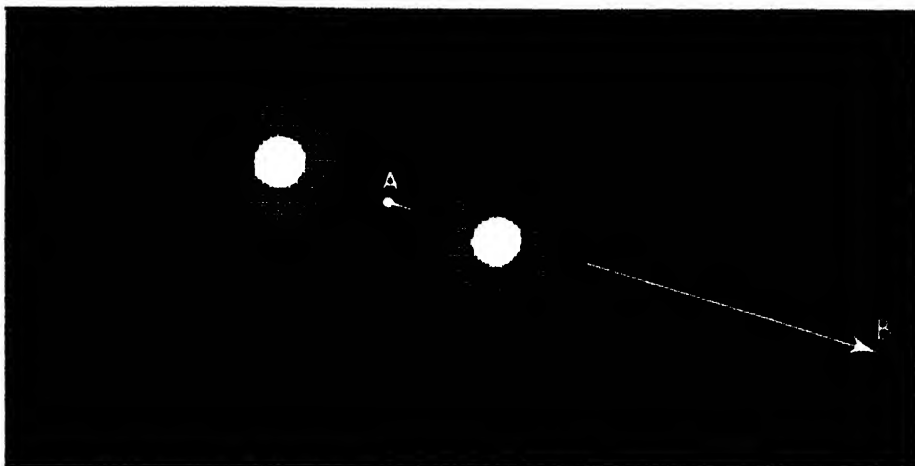
ANOTHER excellent piece of work by Dr. Jones which has recently appeared may well be described at this time. The bright star Procyon has long been known as an interesting binary. The discovery that it was double was not made by direct telescopic observation but as a result of the discussion of a century's observations of its position in the heavens. For so bright a star, observations of the right ascension and declination have naturally been numerous. These show that it is moving in the heavens at the unusually rapid rate of $1''.24$ per year. A single set of good observations should fix the star's place with an average error of about $0''.3$, so that a single year's interval would suffice to show that it was moving.

But when a long series of observations were collated, a strange thing appeared. The star was not moving in a straight line but in a wavy curve. A straight line (to be exact, a great circle on the celestial sphere) can be drawn so as to keep close to the actual observed track, but the latter oscillates back and forth across it, deviating to a distance of about $1''$, which is very

uniformly in a straight line; but the bright star itself circulating about this center would move in a wavy curve. The star came back to the same part of successive waves of the curve in 40

could expect to see it close to the latter.

To work out the exact orbit of such a system is a hard problem. The micrometer measures of the companion



Courtesy of Discovery (London)

APPEARANCE OF NOVA PICTORIS ABOUT APRIL FIRST

The rings are thought to have resulted from the use of a lens corrected for the blue end of the spectrum. Thus the other colors were out of focus, and each color caused its ring

years' time, so that this was evidently the period of the orbital motion.

All these facts were brought out by the great German astronomer Auwers when a young man, in 1862. Since then the star's motion has continued to follow the same wavy curve.

But why was the faint companion not seen? The answer came in 1896 when Schaeberle, with the great Lick telescope, detected a tiny attendant a little less than $5''$ from the bright star. It was so faint that it taxed the powers of the 36-inch instrument and the failure of observers to see it with smaller telescopes was at once explained.

From 1896 to 1914 it was followed by several observers and found to move

cover but a part of the orbit and are not very accurate on account of its faintness. The observations with the meridian circle which extend from 1755 to the present, cover more than four complete revolutions. But when the computer starts work upon them he must take all sorts of precautions. The minutest errors must be found and eliminated, much calculation must be done, and a final solution reached.

SUCH work is exceedingly laborious. The mere account of Dr. Jones' work containing only the observational data on which it is based, and a general summary of the methods and results, occupies nearly 40 pages. The original calculations would make a far larger pile.

At the end after a full consideration of all the various data he reaches highly satisfactory results which account for the whole observational material accumulated during 170 years. The period of the companion "O" motion is 40.23 years; its mean distance $4''.26$; the eccentricity of the orbit 0.310, and its inclination $30^\circ.6$.

The parallax of Procyon has been accurately observed, and it follows that the mean distance of the companion is actually just a little less than 14 times that which separates the Earth and the Sun, and therefore almost half between those of Saturn and Uranus. The mass of the brighter star is 1.24 times the Sun's, so that it is a good deal like the latter, though somewhat heavier, hotter and brighter. The companion has but two fifths of the Sun's mass. Even this is unusually large in proportion to its brightness and it is probable that it is a "white dwarf" like the Companion of Sirius which behaves similarly.—London.



Yerkes Observatory

ORBITAL MOTION OF A DOUBLE STAR

The three photographs of the star Kreuger 80 were taken, respectively, in 1908, 1915 and 1920. During that period of time the faint companion's position angle changed about 90 degrees

much greater than could possibly be explained by any errors in the observations. The only reasonable explanation was that the star must be double, having a companion so faint as to be invisible in the telescopes which then existed.

The center of gravity of Procyon and its faint companion would move

steadily around Procyon in the direction indicated by Auwers' calculations. Then it gradually drew nearer to its primary and for the last dozen years it has been invisible, lost in the glare of the bright star. According to the latest estimates the companion is less than one one-hundred-thousandth part as bright as Procyon, so that no one

Taming

Unique Concrete Withstand

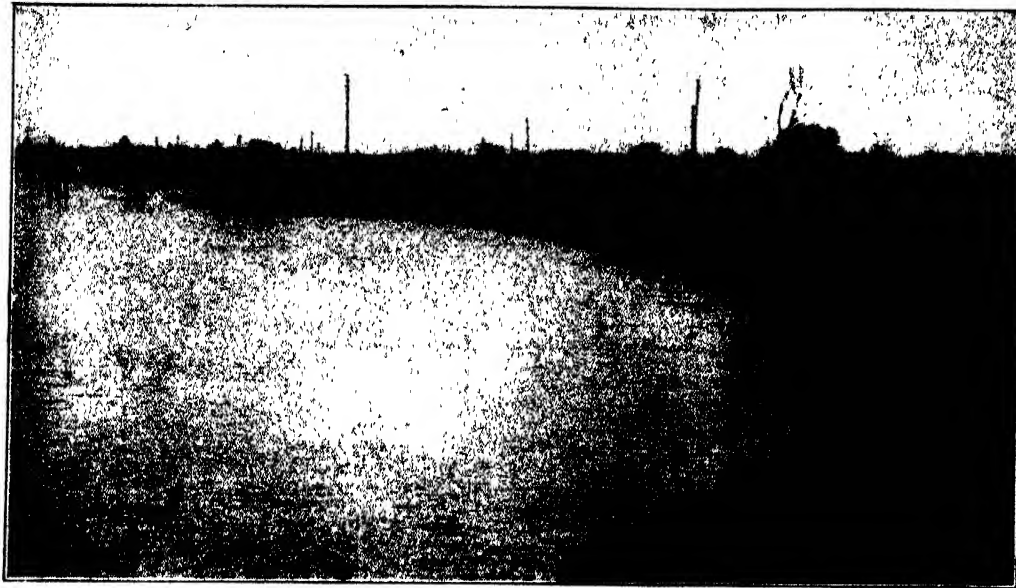
12-inch by 12-inch heavily reinforced concrete legs. Since their bases were imbedded in the sand and they were fastened to adjacent tetrahedrons with seven lines of cable, these six were pulled apart as the 14 tetrahedrons below them were swept toward the river bank.

With six broken and the others badly displaced, the row of 30 concrete skeleton tetrahedrons successfully resisted the most tremendous

flood that ever rushed down the river channel. The earth approach to the west end of the bridge was not damaged, for the water was deflected by the tetrahedrons to its proper course under the bridge. Large quantities of brush and trees were collected by the protection work, and the area remaining between the row of tetrahedrons and the river bank and also on the stream side of the protection was silted up with about four feet of sand and gravel, thus straightening the channel and leaving conditions better than before the flood as far as the river channel was concerned.

So great was the flow of water that it topped the bridge floor by more than a foot and carried away 240 feet of the pile trestle approach to the bridge, including all of the reinforced concrete pile bents except the westerly shore span. A hundred feet or more of the bridge deck was thrown up high on the west river bank, where it lay for some time intact, 300 or 400 feet from where it was displaced.

If the Santa Clara River were allowed to choose its own course, it



BANK OF SANTA CLARA RIVER AFTER A RAMPAGE

After the flood waters of the storm of February, 1927, had subsided, a great slice was found to have been cut from the bank. The tetrahedrons were installed here to prevent further cutting

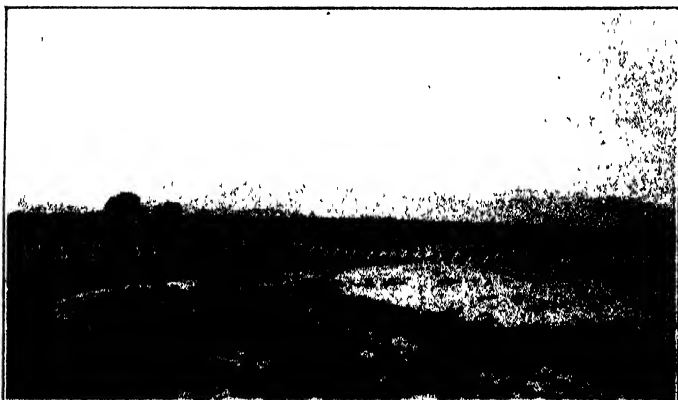
THE recently completed river-bank protection at the western end of the Santa Clara River state highway bridge near Montalvo in Ventura County, California, although damaged and badly displaced by the terrific flood resulting from the failure of the St. Francis Dam, proved effective and prevented damage to the state highway, to the Southern Pacific Railroad and to the abutting property, which, without this protection, would have amounted to many times the original cost of the bank protection.

Except for the line of defense made by these reinforced concrete tetrahedrons, the rushing flood waters would have washed away many acres of fertile ground on the west bank of the river and would have washed away the earth embankments at the west of the state highway bridge and of the bridge on the main Coast Line of the Southern Pacific Railroad.

Standing directly in the path of the torrent, the bank protection, consisting of a row of 30 reinforced concrete skeleton tetrahedrons extending out

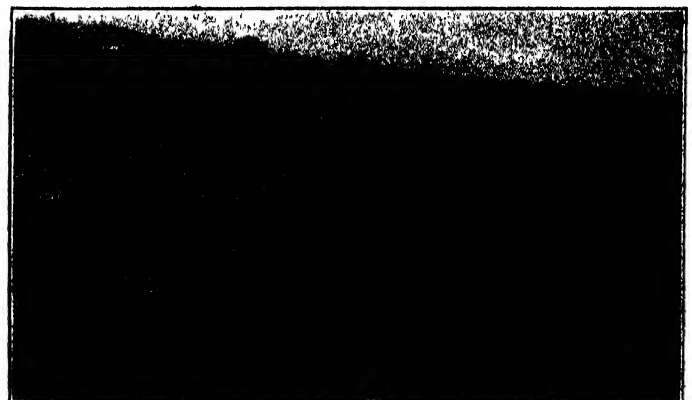
from the river bank to deflect flood water under the main bridge and to protect the west approach, was struck by a wall of water 15 feet high. This wall of water carried with it a mass of large, uprooted trees, telephone and power poles, and portions of buildings and barns which had been destroyed by the flood. This battering ram was at work for several hours in its attack on the westerly approaches of the highway and railroad bridges. The force of the rushing waters was so tremendous that the entire row of 30 tetrahedrons, weighing over 200 tons and laced together with seven lines of one-inch cable, was swung back 150 feet toward the river bank at the downstream end, pivoting about the heavy concrete anchor at the bank on the upstream end, which held firm.

SIX of the 30 tetrahedrons—those located most centrally in the low water channel and which had become partially imbedded in the river bottom during a previous high flow of water—were torn to pieces by the torrent, which snapped and broke the



COMPLETED PROTECTION WORK

The line of unique concrete forms installed and anchored to the bank at about the point from which the photograph at top of page was taken



AFTER FAILURE OF ST. FRANCIS DAM

When the flood waters swept by, the tetrahedrons were twisted but the area behind them was raised about four feet by a soil deposit

a Turbulent Torrent

Forms for Preventing Disastrous Erosion. St. Francis Dam Break Flood

By E. T. SCOTT

Engineer, Division of Highways, California

would most likely meander out of its regular channel, in a manner similar to that of the Mississippi, rather than flow under the 2077-foot state highway bridge near Montalvo. On several occasions during the last few years the river, swollen by flood waters, has swung sharply to the west, cutting away the 15-foot embankment on that side of the river and destroying several acres of agricultural land.

During the storm of February, 1927,



POURING CONCRETE

Concrete for the top was poured by means of a tetter beam. Note sheet-iron corner forms

the river took another swing to the west at a point about 1200 feet upstream from the state highway bridge and continued to wash away the high river bank until it threatened to cut through the west approach to the bridge. Only the vigorous action on the part of the maintenance organization prevented the highway from being washed out.

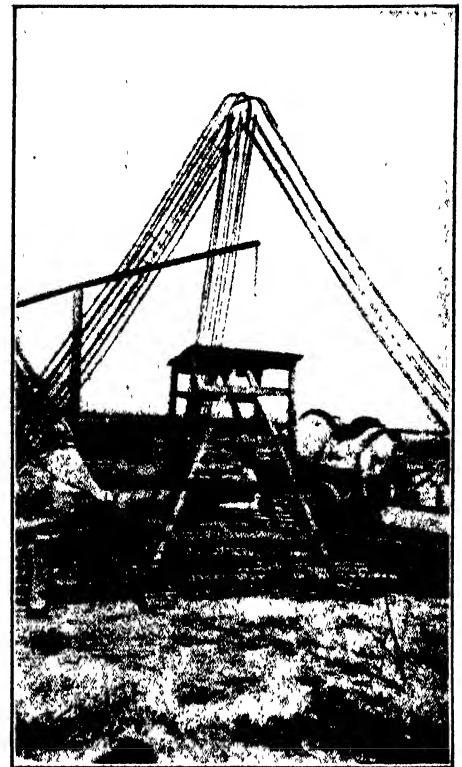
The trees, cable, and brush used successfully by the maintenance crew during the storm, in preventing the flood waters from cutting through the highway, offered but a scant barrier to further inroads from the stream during floods of the winter to follow. Studies were made to determine the best means of bank protection for the particular case. An inspection made of various types of bank protection work used on the Santa Clara River showed

that the only type of permanent bank protection that had successfully withstood the floods was the concrete skeleton tetrahedron.

This form of protection to control the river was first employed by Dan Sheldon, a rancher who has owned and operated for many years a 400-acre ranch immediately north of the state highway and located along the west bank of the river. As long ago as 1912, Mr. Sheldon constructed and placed at strategic points along the river, concrete tetrahedrons which he invented and which have since been most successful in controlling the flood waters of the river adjacent to his property.

STANDING 13 feet high, composed of six 16-foot legs a foot square, well reinforced with steel, and weighing about seven tons each, these forms are capable of withstanding a tremendous force.

Should the tetrahedron be undermined or even toppled over by the flood, it still stands on a broad base, always offering a resistance to the on-rushing water. Several years ago one of the heavy tetrahedrons standing at the end of a row, and not cabled to the adjoining tetrahedrons, was washed a quarter of a mile downstream by the flood. It took hours for the heavy concrete figure to cover the distance because each time it rolled to a new

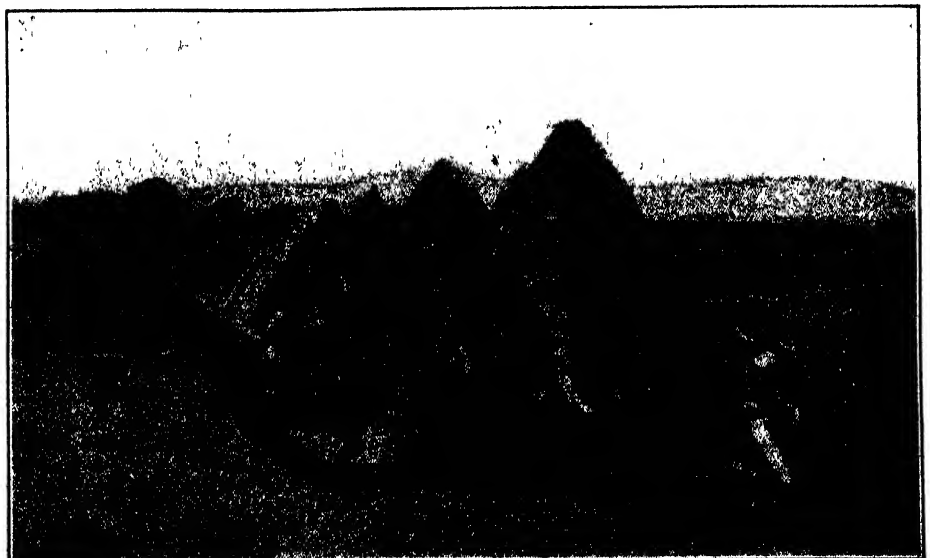


ASSEMBLY OF REINFORCEMENT

Reinforcing rods were assembled in position before the concrete forms were constructed

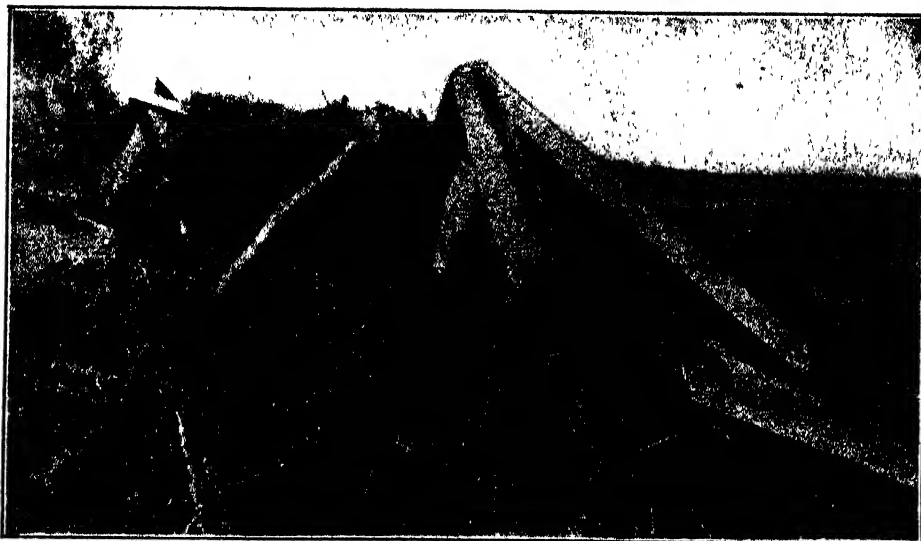
one of its four similar bases, it stood upright, always resisting the force of the river. After the storm the strayed tetrahedron was dragged back to its place with a tractor, having suffered no damage during the trip.

A large amount of driftwood and brush is carried by the Santa Clara River during flood times. Soon the drift begins to accumulate against the row of concrete tetrahedrons which are now laced together with cables. As the tangle of brush increases, the swift current of the river is retarded a little, and the silt and sand carried by the water begins to drop and accumulate



THE ROW NEARS COMPLETION

A man may be seen directly behind the first tetrahedron of the row which is anchored at the farthest end. At this stage the deepest part of the low water channel had been crossed



PROOF OF THE EFFECTIVENESS OF THE WORK

Debris brought down by flood waters, was caught by the forms and served to assist in holding back the flood. Although some of the tetrahedrons were damaged, they were effective

both above and below the obstruction to form a strong wall, and the river veers back to its old channel.

In order adequately to protect the highway embankment leading to the bridge and force the river over toward its old channel, a row of 30 of these concrete skeleton tetrahedrons, placed approximately 19 feet apart from center to center, was constructed along the west bank of the river on the upstream side of the bridge. Nearly 600 feet in length, this row was installed at an angle swinging downstream from the river bank so that it crossed a newly cut low water channel.

During the construction of this row, ranchers owning property along the east bank of the river over 2000 feet away, objected to the continuation of the work as originally planned, fearing that flood waters would be forced across the river to do damage to their property.

IN order to appease the complaining ranchers without lessening the effectiveness of the protection work, an angle was thrown into the line and the six tetrahedrons farthest from the bank were constructed at a right angle to the direction of the bridge.

In constructing these tetrahedrons, steel reinforcement consisting of eight one-half inch bars for each 16-foot leg, was assembled where the tetrahedron was to be constructed. The two outside corner bars of each leg were cut 17 feet, six inches long and, when installed in place, the ends were bent into and tied to the opposite corner bars of adjacent legs. The remaining six bars of each leg were 14 feet long and were placed so that their ends projected past the ends of bars in the other legs at the corners. A spiral reinforcement of Number 8 wire was then wound around the longitudinal reinforcing bars with a pitch of six inches. Sheet iron corner forms

were then slipped over the reinforcing bars at the three corners of the base and wooden forms for the legs set in place. A sheet iron corner form similar to those used on the base corners, but



TIED TOGETHER WITH CABLES

Forms were tied together with old one-inch cable which was wrapped around the legs

having a small opening at the top to admit concrete, was used at the vertex of the tetrahedron.

Concrete was poured into the lower

part of the tetrahedron directly from wheelbarrows. As the construction progressed, concrete was shoveled into the forms, while the last few cubic feet of concrete to be placed at the top was elevated by a bucket attached to a portable swinging teeter beam.

The completed tetrahedrons were placed with the 16-foot sides in line on the upstream side and the points of the equilateral bases downstream. A space of three feet was left between the corners of adjoining tetrahedrons on the upstream side.

Six lines of old one-inch cable secured from nearby oil fields, were stretched along the upstream side of the row and one line along the downstream side. The cables were fastened by simply wrapping them around the legs of the tetrahedrons and by the use of cable clamps. The purpose of the cable was to tie the whole row of tetrahedrons together so that they would act as a unit during a flood to catch and hold the brush and trees carried down by the storm waters.

AT the attached end of the protection work, the cables were cast into a large block of concrete which anchored them at a safe point to the river bank. Some brush was then piled near the bank to prevent any possible cutting away of the bank behind the protection work.

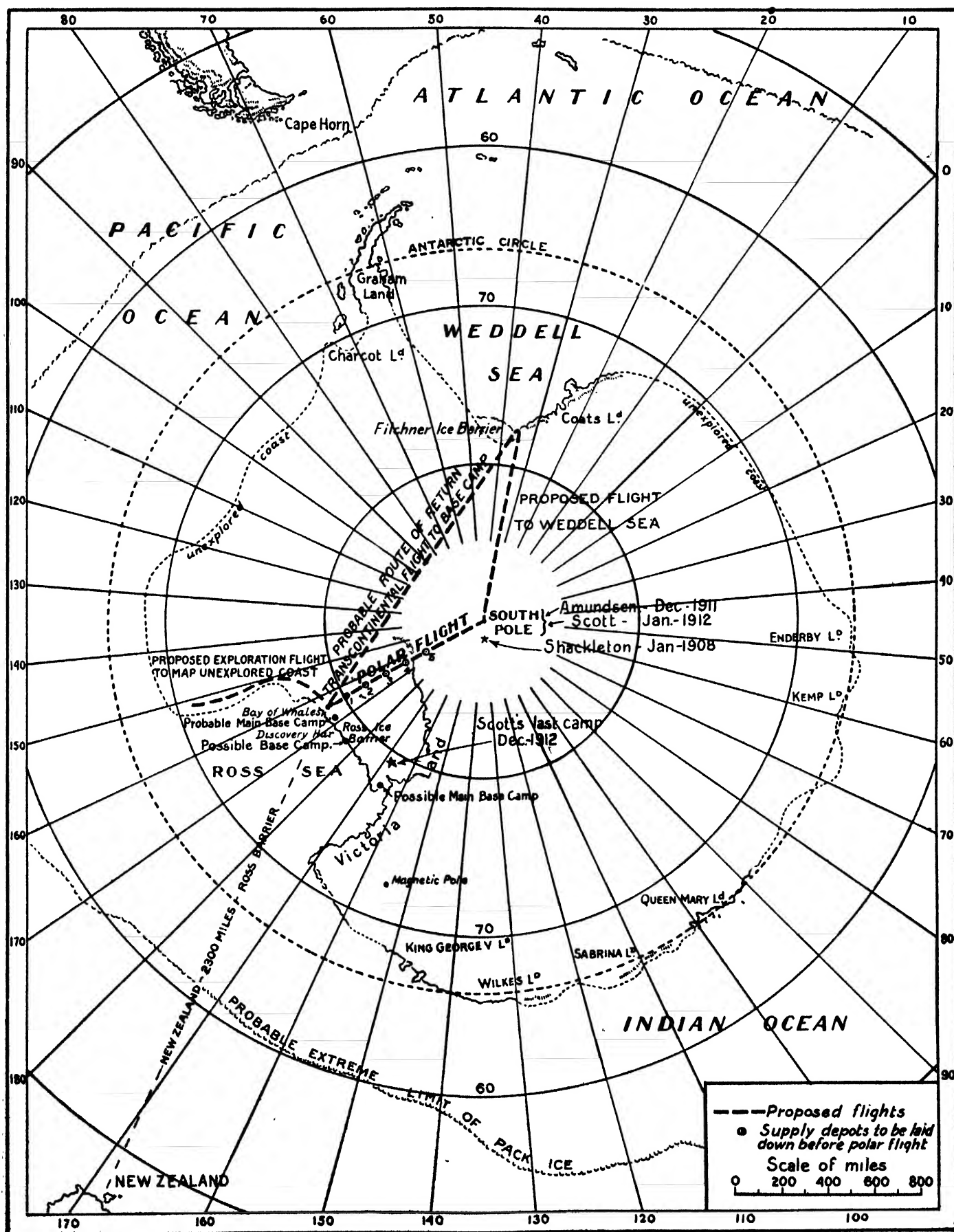
The reinforced concrete tetrahedrons were constructed at a cost of about 112 dollars each, exclusive of the cables, and at the cost of construction of a temporary road into the river bottom, and of a ditch which was necessary to deflect the river away from the construction work. The cost of the protection work, including all expenditures, was a little over seven dollars per lineal foot.

The work of constructing these forms was all done by a day-labor crew with a foreman in charge.



SIXTEEN YEARS OLD AND STILL GOOD

Although somewhat displaced, these old tetrahedrons still successfully combat the floods. Note how the land behind them has been filled in due to the protection afforded by them



Byrd's Proposed Antarctic Route

ALL the world will be reading of and listening to reports of Commander Byrd's antarctic flights. From all available sources of information, we have drawn a map to give the essential facts of previous South Polar

exploration, yet the map has been kept as clear as possible so that the reported positions of the Byrd expedition may be plotted in by our readers, as they are received from time to time from his powerful wireless on the *Sampson*.

The Month In Medical Science

A Review and Commentary on Progress in the Medical and Surgical Field

By MORRIS FISHBEIN, M. D.

Editor of the Journal of the American Medical Association and of Hygiene

Ventilation of Schools

THE executive secretary of the New York Commission on Ventilation, Mr. Thomas J. Duffield, has recently made a series of studies to determine the best type of ventilation for schools. An associated investigation dealt with the amount of fresh air required by the average child in school. In one study conducted in Cattaraugus County, New York, 48 rooms in 41 different buildings were investigated. Regular observations were made of the temperature and of the humidity. Schools heated by furnaces were compared with those heated by jacketed stoves and ordinary stoves. In addition to these factors, records were kept of the incidence of coughs and colds among the pupils and of the relationship between such symptoms and the temperature and humidity.

Previous investigations made by the Commission had shown that for purposes of school ventilation, window ventilation was probably as good if not superior to forced ventilation by especially designed ventilating sys-

are great between the floors, the ceilings and the centers of the room in rooms in which provision is not made for circulation of the air. Mr. Duffield says:

"In general, the prevalence of respiratory illness shows an inverse relationship to outdoor temperatures; that is, the incidence of respiratory illness is greater during the cold months of the year. In the absence of other factors, however, low temperature itself does not appear to be directly associated with increased respiratory illness.

"During periods of low temperature, deviations from the general trend of the incidence of respiratory illness vary with the fluctuations in precipitation, the maximum effect occurring in the week following that during which an excess of precipitation occurred. As spring approaches and the outdoor temperatures become higher, the effect of precipitation is not nearly so pronounced as during the periods when average outdoor temperatures are below freezing."

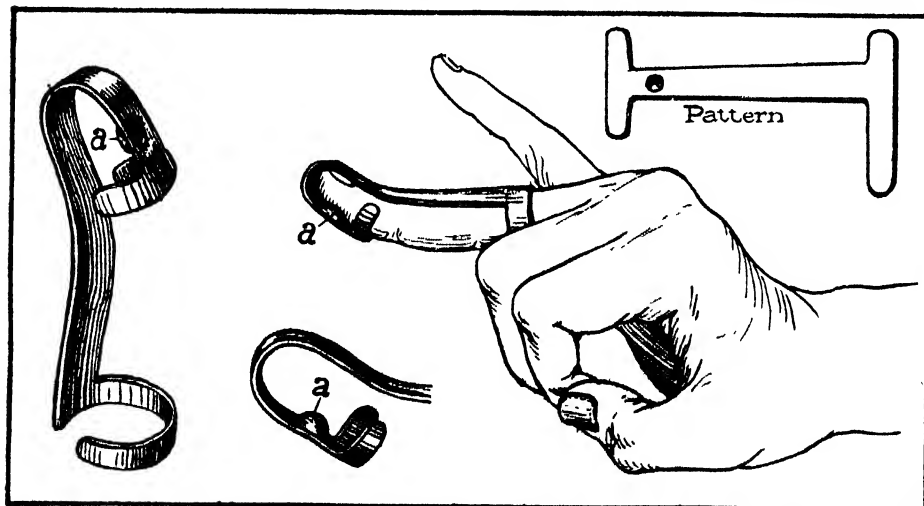
The investigations made relative to

to keep the room temperature from exceeding 66 degrees Fahrenheit.

In this connection Mr. Duffield points out that the mechanical ventilating systems are usually shut down long before outdoor temperatures average 55 to 60. It therefore remains for heating and ventilating engineers to provide first a heating plant that will just compensate for structural heat loss over a wide range of outdoor temperatures, and second a means of introducing quantities of air varying with the average ages of the pupils and the outdoor temperatures in a manner that will not produce draft.

An Improved Splint for Baseball Finger

WITH the coming of summer, innumerable young men who reach with "butter-fingers" for baseballs suffer exceedingly until the jammed up joints straighten out. Dr. Philip Lewin designed a splint for the care of such fingers which is exceedingly simple and which is of great aid in securing a prompt restoration of service. The splint is made of aluminum and is molded to fit the individual case.



ALUMINUM SPLINT FOR HOLDING FINGER JOINTS

Several views are shown. The ball-like prominence *a* produces hyperextension of the end phalanx

tems. Previous investigations revealed the fact that there was less respiratory disease in rooms with moderate temperatures than in those which were over or underheated.

Among other interesting observations it was found that rural schools heated with furnaces and jacketed stoves are more likely to be overheated than the rooms heated with ordinary stoves. Differences in temperature

the amount of fresh air required by the school child indicate that 30 cubic feet of fresh air per minute are required to keep the temperature of a room occupied by fifteen-year old pupils from exceeding 66 degrees Fahrenheit when the outdoor temperature reaches 55 degrees Fahrenheit. First grade pupils require 30 cubic feet of fresh air when the outdoor temperature is 60 degrees Fahrenheit

The Place of Copper in Nutrition

SECOND only to the fundamental discovery of Steenbock in relation to the irradiation of food is the announcement of the work of Waddell, Elvehjem, Steenbock and Hart to the effect that copper is a substance of the greatest importance in relationship to the building of blood in the human body. Heretofore it has been the general belief that iron is the one mineral substance of primary importance in this connection.

The Wisconsin investigators found that highly purified inorganic salts of iron did not increase the level of red coloring matter in the blood of animals which had been made anemic by being put on certain diets which invariably produce anemia. On the other hand, certain natural foods, such as liver, lettuce and corn are remedial. When these food substances were reduced to ash, these extracts were found to be effective. They therefore determined that some other substances besides iron must be responsible.

An analysis of the ash indicated that a trace of copper invariably present in the ashes of any natural foods, if supplied along with iron salts, elimin-

ated the hazard of anemia when the animals were fed with the diets that have been mentioned. The occurrence of copper in plant and animal tissues has been known for some time. Many investigators find it in the human blood, in an amount approximating 0.0017 milligrams of copper per cubic centimeter.

Here is another metal added to the



BARRACUDA

Sphyræna barracuda and 11-year old boy, showing relative size of the dangerous fish

many that are already known to be of great importance in the human body. The sophistication of modern diets has tended to elimination of the mineral salts. Now scientists are beginning to find that these things are of the greatest importance to the human organism, even though the amounts concerned are so infinitesimal as to represent frequently merely a trace.

The Danger From Electric Shock

DURING the year 1926-1927, 64 men were killed by high voltage electric shocks in New York State. It is now recognized that currents of from 100 to 250 volts may be dangerous, and contact with high tension currents up to 100,000 volts that are now employed to transmit electric energy over long distance is realized by everyone to be dangerous.

Electrical burns are treated as are other burns. However, conditions of fibrillation of the heart, stopping of the respiration and sudden death from electric shock are not usually treated correctly. Recent investigations indicate that prompt efforts at resuscitation, including vigorous attempts at artificial respiration, will save many lives.

The paralysis of the breathing apparatus is apparently temporary in many cases; if artificial breathing is kept up long enough, patients may re-

cover who would otherwise die. Experts therefore recommend that movements of the chest should be started as soon as possible and continued even for hours in such cases. The only reason for discontinuance should be unmistakable signs of death.

Botulism in 1927

SOME years ago the country was startled by numerous outbreaks of botulism due to the eating of ripe olives that had been contaminated with this germ. The ripe olive industry supported scientific investigations which have resulted in cleaning up of this danger. The canning industry in general has also paid particular attention to the prevention of botulism and the results have been notably successful.

From 1899 to 1927 there were 150 outbreaks of botulism reported in the United States and Canada, with one outbreak in England and one in Argentina, giving a total of 518 cases with 347 deaths. The mortality was thus 67 percent, which is one of the highest mortalities known in medicine. The disease is rapidly fatal, and for this reason demands so much medical interest. Only five outbreaks occurred in 1927, whereas there would have been 13 if the condition had occurred with the frequency with which it used to occur.

All of the outbreaks in 1927 were due to home-canned foods—in two cases corn, in two cases string beans, and in the remaining cases pears. In four of the cases the food was noticeably spoiled before it was used but the people ate the food anyway. As a result of these five outbreaks, 11 persons became ill and 10 of them died. In one of the outbreaks an entire family was blotted out, the food taken being canned corn which had been made into soup by a child. Four persons ate the soup and all four died. The food had been heated in the making of the soup,

but apparently insufficiently to protect against the poisoning.

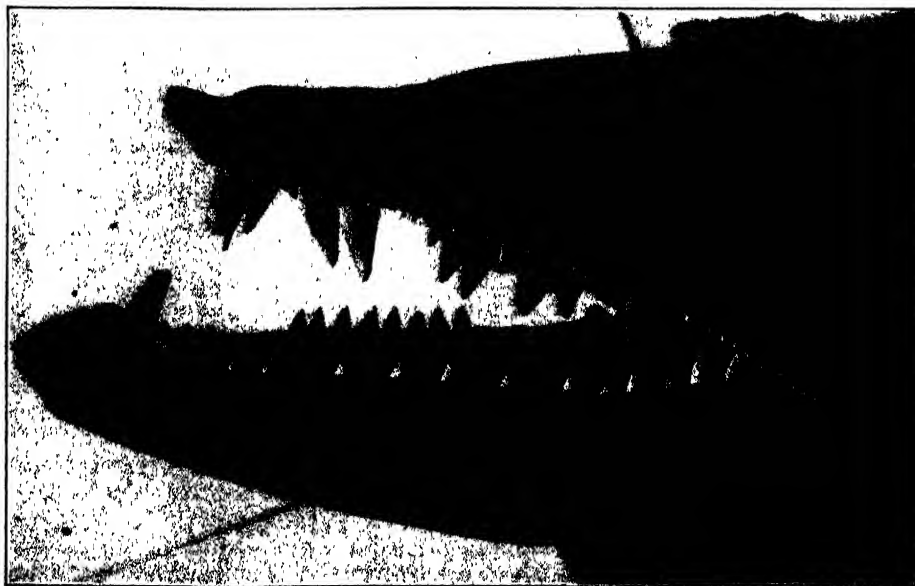
In commercial canning, sterilizing processes have been standardized to such an extent that the industry may be said at this time to be safely conducted for public health.

The Barracuda—A Fish Most Dangerous to Man

THE *Journal of the American Medical Association* called attention recently through an article by Dr. E. W. Gudger of the American Museum of Natural History and C. M. Breder, Jr., of the New York Aquarium, to the fact that the barracuda, a large savage pike-like fish, is probably one of the most dangerous fish that exists in tropical seas. A case is described in which a barracuda attacked a sailor of the United States Navy who was swimming in the ocean near Panama. In that case the sailor was bitten so severely that his limb was almost torn to pieces.

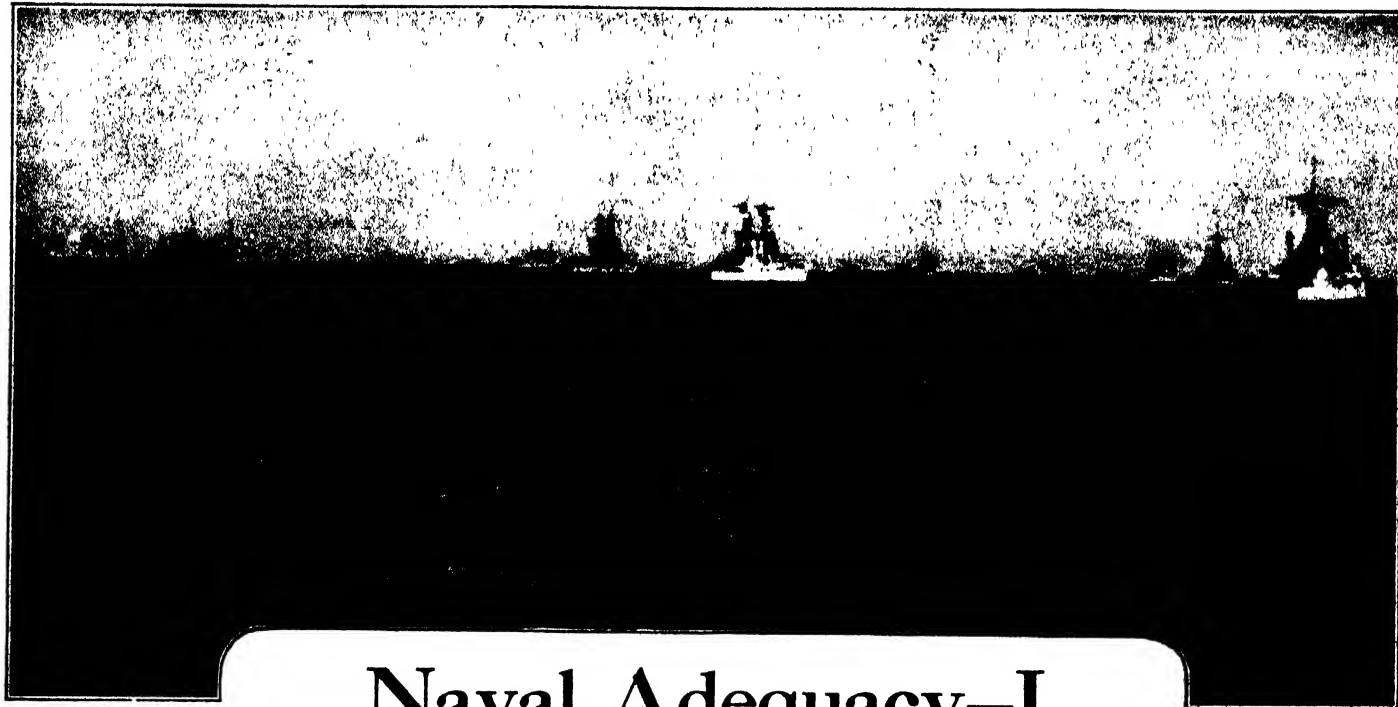
As can be seen by the illustration, the barracuda is almost as large as a twelve year old boy and its mouth is such that any bite is likely to result in severe injury.

The authors report many other instances in which this fish has attacked human beings, sometimes causing death and in other cases the loss of limbs. It is pointed out further that the barracuda is recognized by all of the natives of the Caribbean-Gulf region as more apt to attack man than is the shark. This is due to the fact that its food getting depends on what it sees more than on what it smells. It is attracted by any flashing object, and is likely to strike immediately. It is known, moreover, never to strike more than once. The New York investigators are convinced that the barracuda is the most dangerous to man of all of the fish of the sea.



MOUTH AND JAWS OF A 55-INCH DRIED BARRACUDA

There are two sets of teeth in the upper jaw and only one in the lower



Naval Adequacy—I

*Naval Bases Constitute a Primary Element of Naval Strength.
The United States Has But a Few, Many of
Which Are Woefully Inadequate*

By CAPTAIN N. H. GOSS, U. S. N.

The Truth About the Navy

THE accompanying article is the first of a naval series in which we asked Captain Goss to give us the benefit of the broad knowledge of naval questions which he has gained by thorough training, years of experience as a naval officer, and participation in war games of the fleet. Our sole purpose in publishing these is to state authoritatively the case for the navy, to bring order out of chaos, and to show the navy's present handicaps and requirements.

SCIENTIFIC AMERICAN is a strong proponent of naval limitations. We realize, however, the necessity of maintaining our navy so that it provides adequate military protection based upon our specific naval problems which, assuredly, are different from those of other powers. These problems retain their relative proportions regardless of limitations. In his articles, Captain Goss discusses the many varied elements embodied in the broad subject of naval strength and shows their relation to each other by the same method naval experts employ to determine what constitutes an adequate navy.

No war hysteria should be included in a discussion of this nature. Great Britain and Japan are mentioned in this series of articles only because these two nations happen to be comparable, in naval power, to the United States. Any plea for adequate naval strength must, therefore, be predicated upon a study of their strength, as well as upon consideration of our own absolute needs.

—The Editor.

SEA-POWER is an inclusive term since so many elements constitute naval strength. First there are the "positions" of which Napoleon used to talk; and these positions, upon which ships may rely for fuel, shelter, and repairs, are, in many cases, even more important than military positions on land; for ships have to go somewhere and can stay at sea for a limited time only. Hence their usefulness and the areas in which they are able to operate depend almost entirely upon these strategic developed

positions which are called naval bases.

Ships are naturally a cardinal element of naval strength and in these modern times the word is an inclusive term as well, since it encompasses not only combatant men-of-war but also plane-carriers, aircraft, tenders, repair vessels, and finally, merchant ships for the transportation of supplies.

THE third cardinal division of naval strength is personnel, for, at sea especially, it is still the trained man behind the gun and in the engine room that counts; efficient naval personnel cannot be improvised overnight no matter how great may be the general

resources in man power of a nation.

Trained personnel is an especially important factor of sea power also, because to a maritime country like ours, without powerful continental neighbors, the navy is the first line of defense, the first to meet the shock of conflict, the outer bulwark behind which the country has to mobilize and organize in time of stress; hence to be of value it must always be ready and efficiently maintained in time of peace.

It is only natural that one hears more of the discussion about ships or aircraft or some of the more easily recognizable elements of naval strength than one does of the more prosaic fac-

The illustration at the top of this page shows the fleet at Lahaina Roads, the only fleet anchorage in Hawaii. Unsheltered from the west, this open roadstead lacks harbor facilities.

tors of naval bases and personnel, but these more silent partners are not less important. We hear a good deal of the general term, *adequate navy*. It has been included in party platforms for years, but we do not hear so much of what *constitutes* an adequate navy. If we look into it, however, the term is not so hard to define, for a navy is adequate when it is equal to its allotted tasks and able to support and defend the country's policies.

The tasks that fall to the navy's lot depend naturally, to some extent, on the strength of the other principal naval powers, but, first of all, they depend upon geography; the location of the country and the length of its coast lines; the location of its harbors and their shelter, commercial, and repair facilities; whether it fronts on one or more oceans; the location of its possessions and whether they are self-supporting; whether the country is dependent on imports of essential commodities and, if so, the location of its trade routes; the communications between the different coasts of the home-land and its possessions; the quality of the harbors either developed or suitable for development into naval bases; and the distances between important ports in the home land, between its coasts, and to its important possessions.

This leads naturally into a discussion of the first primary element of sea power, viz., naval bases. It is not the purpose in this discussion to go deeply into the question of home-land defense of the principal naval powers, since it is to be conceded by a non-aggressive country such as ours, that each of these powers should be supreme in her own waters. It is particularly unnecessary to discuss this in the case of Great Britain which is but a small island country possessing many good harbors close together, with very extensive and quite ample repair, docking, and shelter facilities. The same is true of Japan, although her location so much nearer to our own possessions in the Far East, and her encircling position in front of our markets in China, are a matter of concern to us. Suffice it for the moment, however, to say that Japan, too, has these facilities in ample measure.

SINCE it so happens that the United States, the third of the principal naval powers under discussion, is the only one that is a continental nation fronting on two oceans, distant from each other many thousands of miles by sea, the naval defense of this country is inherently a more complicated and difficult problem. While the British or Japanese home fleet could, in a matter of hours, steam from port to port and encircle either the British or Japanese islands, it would take a matter of days for such a

fleet to cover even one of our two coasts. We see, then, how geography is inherently such an important factor in naval strength and how, since a fleet cannot be in two places at once, it determines in advance the fact that considerable force is required to constitute an adequate navy for the United States.

Each of the three powers under discussion has extensive possessions outside its home land area. Of these, the Japanese are by far the more compact. Korea lies only a few miles across the Sea of Japan; Port Arthur and the ports of Manchuria, where she at present exercises a predominant interest, are just beyond. Her main group of islands encircle the principal ports of China with whom she has, to say the least, trade connections of extreme importance. The mandate islands composing the Marshall and Caroline groups are relatively close at hand, the farther group being not more distant than San Francisco is from the Hawaiian Islands.

GREAT BRITAIN, as every school-boy knows, has possessions covering the seven seas. In this discussion, however, we are not concerned with those in the European zone, in Africa, or in the south Pacific, but only with those that lie off our own coasts, along the approaches to the Panama Canal, across the trade routes to South America, or near our present possessions in the Far East. These will be referenced in some detail, since they contain harbors that are of present or possible use for ships, some being developed naval bases, some with commercial facilities, many that at least offer shelter, and some that are readily capable of development into advanced naval bases.

All these points affect naval

strength and have a bearing on what constitutes an adequate navy. Beginning near our own coasts, the British have Bermuda a few hundred miles distant—say a few hours by air. Bermuda has a small naval station; a naval drydock capable of handling destroyers, submarines, and light craft; extensive sheltered anchorage space; some degree of fortified protection; and is, on the whole, admirably adapted for use as an advanced naval and air base.

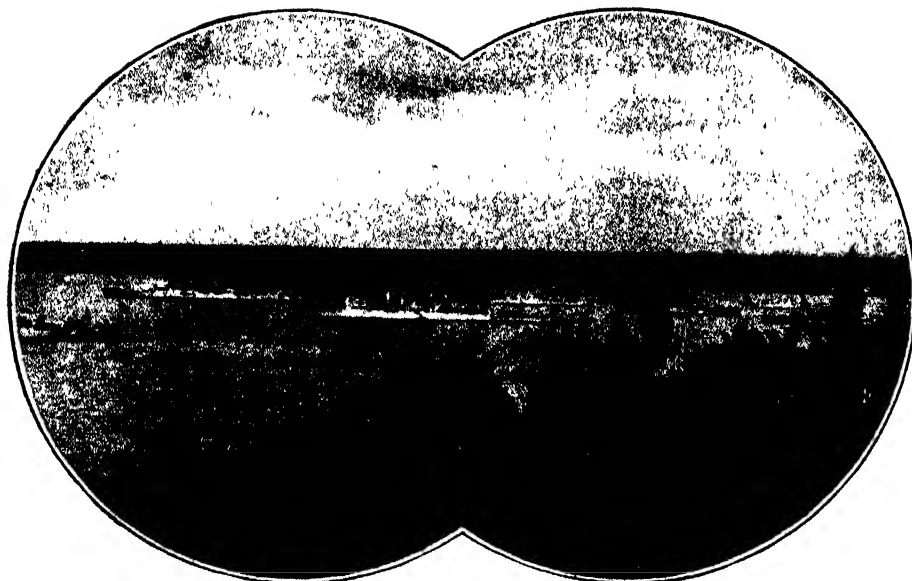
A little farther down towards the Caribbean and directly on our route to Panama, Great Britain owns the Bahamas with their various sheltered anchorages. Inside the Caribbean, still on the route to Panama, she possesses Jamaica which has many resources of supply, considerable harbor developments, and is partially defended. Along the eastern fringe of the Caribbean, Great Britain owns most of the Leeward and Windward Islands which lie along the trade route to South America. Some little commercial facilities exist in various of these islands; and under the lee of St. Kitts and Nevis is the fleet anchorage alternately used by the French and British fleets during our colonial and Revolutionary War period.

TO complete the chain encircling the eastern Caribbean, the British have Trinidad with a sheltered anchorage sufficient for any navy. On the north coast of South America lies British Guiana and up the Central American coast from Panama we soon come to British Honduras on the flank of the route into the Gulf of Mexico. None of these latter possessions are fortified in a modern sense but all have some shelter, many of them have some commercial harbor facilities, many offer some supplies of various natures, and



THE HARBOR AT SAN DIEGO

This is the principal destroyer, submarine, and air base on the west coast. The harbor is small and the channel too shallow for our new aircraft carriers. The air base dock is shown on right



BEAUTIFUL HILO HARBOR, HAWAII

Although this is our principal port in Hawaii, it is but a small harbor open to the sea. It will be seen that great crowding is necessary in order to anchor only a small part of the fleet

all have potential value when in the possession of a foreign power.

IN the Pacific we shall, as noted heretofore, concern ourselves only with foreign possessions that lie along our lines of communication with our present possessions in the Far East. Of the three routes, the northern one, by way of the Aleutian Islands, is effectively barred for reasons that will be discussed later with reference to the treaties emanating from the Washington Conference. The southern route, by way of Samoa, although the longest, has some potential value since it is the most direct route from Panama. The British now have the former German possessions in Samoa itself; the Fiji Islands about 650 miles away; anchorages of some consequence in the New Hebrides and Solomon Islands; and an extensive fleet anchorage in the Admiralty Islands just off the coast of New Guinea. Near the Philippines, only 600-odd miles across the China Sea from Manila, lies Hong Kong, a British possession of many years standing, with the best dock, harbor, and base facilities on the China coast. Furthermore, the British are developing at Singapore, less than 1400 miles from Manila and less than 1000 miles from the western portion of the Philippine group, a great naval base of first magnitude destined to be their main position in the Orient. It will be an ample, fortified base capable of docking their largest vessels.

To complete the picture of the inquiry into the bearing of naval bases on sea-power, we will now consider our own possessions. In the strategic areas which encompass the defensive areas off our own southern coasts—our vital communication lines in defense of, and through, the Panama Canal, and with South America from

which we must import essential commodities such as sugar, coffee, nitrates and manganese—we have a small naval station at Guantanamo on the south coast of Cuba, 60 miles westward from Windward Passage. This is unfortified, has very limited fuel and supply facilities, no repair facilities of importance, no drydock, and is of too limited extent to shelter the major portion of the fleet.

We have close political and trade relations with Cuba, Haiti, San Domingo and the Central American countries north of the Panama Canal, but on none of these could we rely, in case of war, for anything beyond benevolent neutrality. The canal itself is strongly fortified as an outpost but its continued possession by us is dependent on command of the sea. Its possession may be considered of paramount importance, and it is certain that its defense could not be neglected in determining the naval strength of the United States.

WHILE we have ample docking and repair facilities at our bases on the Atlantic coast, we are not so fortunate on the Pacific. There is one large dock and considerable repair facilities at Balboa, in the Canal Zone. At San Diego, where our destroyers, submarines and aircraft base, we have our most extensive air base, although the channel and wharfage does not permit our new giant aircraft carriers to enter port. Destroyers there base almost entirely on their tenders, and the improvised repair facilities ashore are not even sufficient to care efficiently for the large number of destroyers laid up at this port of commission. Submarines basing there are dependent entirely upon their tenders. The supply facilities are adequate for peace time but not for war. This port is blessed

by excellent climatic and weather conditions, but its harbor is very limited, is unfortified in a modern sense, and is directly open to gun-fire from vessels at sea.

At San Pedro, where our battle fleet normally bases, there is nothing except an open roadstead and an extremely limited space behind a small breakwater. At San Francisco, one of the best harbors in the world, which is admirably adapted by geographic location, commercial connections, port, supply, labor, market, and other commercial facilities, to be the great natural base on the Pacific coast, there is only one commercial dock down the bay at Hunter's Point that our large vessels can possibly use. True, we have extensive dock and repair facilities 30 miles up the bay at Mare Island, but the channel there is so narrow and shallow that it is very inconvenient even for our cruisers.

Our other base on the west coast is at Bremerton, about 18 miles across Puget Sound from Seattle, where we have two docks capable of handling our largest vessels, and other extensive base facilities and equipment. The use of this base, however, is handicapped by extensive fogs and treacherous currents in Puget Sound, and the base is inadequate to handle properly all the heavy ships of our battle fleet even in peace time.

PEARL Harbor in Hawaii, a few miles from Honolulu on the Island of Oahu, is our advance base in the Pacific. There we have one dock of major size and a slip for hauling out submarines and small craft, extensive fueling equipment, but limited repair facilities. At present, Pearl Harbor is very limited in berthing facilities. Unfortunately, also, the total water area of this natural harbor, even if dredged, is quite too limited to accommodate a fleet. As everyone knows, the harbor at Honolulu is extremely small, and the open roadstead off the harbor is uncomfortable in peace time and would be impractical in war. The only anchorage in the Hawaiian group that could contain the fleet is what is known as "Lahaina Roads," off the Island of Maui. This position is somewhat sheltered to the north, south, and east, but open to the west and incapable of fixed defense except by mines.

The above has been discussed at some length, since this present weakness in base facilities on our Pacific coast itself has an important bearing upon the general subject of other bases in the Pacific. Since ships that are either undergoing repairs or laid up awaiting repairs, temporarily have no military value, they have to be deducted from the strength of the fleet at that particular time. In actual practice, it is seldom possible to have all vessels away from the yards with

the fleet at once, so that the more quickly ships can be refueled, repaired, or overhauled, the less the fleet at sea will be handicapped.

It has to be noted here that at the Washington Conference the Japanese refused to consider any of our suggestions for limitation of fighting ships unless we agreed in advance to abstain from amplifying the base facilities we had in our own oriental possessions, and unless we also agreed not to establish any new bases or fortifications in the Philippines, in Guam, in Samoa, or even in the Aleutian Islands. Students of Pacific problems quickly learn that great distances are involved in this area.

It is nearly as far from our west coast to Honolulu as it is from our Maine coast to Europe. Despite the great advantage of the Panama Canal, it is more than 3000 miles from the Panama Canal to San Francisco, a distance greater than from New York to Europe. It is even farther than this—over 3300 miles—from Hawaii to Guam, and Guam is only a little more than two thirds of the way to Manila. The route directly across from Panama by way of Samoa is naturally still farther. The northern route by way of the Aleutian Islands is much shorter, but no harbor facilities or modern aids to navigation exist in the natural harbors of the Aleutian Islands, and this route leads directly by the main Japanese Islands as well. So at present the only feasible route to the Philippines is by way of Hawaii.

Examining this route we quickly see the strategic and great potential value of the Island of Guam. This island is actually an ideal possession for an advance base since it is compact, about 40 miles long, with high land and rugged shores, and is surrounded by deep water not easily mined. It has a small natural harbor capable of extensive development.

NUMEROUS and abundant harbors abound in the Philippine group. Manila Bay itself could easily shelter all the vessels in the world. Previous to the World War, the entrance to this bay, Corregidor Island, and one or two smaller islands, were extensively fortified. It was never expected, however, that these fortifications could withstand siege operations, and modern aircraft development has still further reduced their resisting power. At Cavite, a few miles across from Manila, is an old naval station, very little advanced since the day of Spanish rule, located on shallow water and capable, at most, of handling only destroyers and submarines. Besides the small marine railway at Cavite and a small commercial one nearby, we have the drydock *Dewey*, also in the Philippines. This dock, capable of handling nothing larger than cruisers, is at

Olongapo on Subic Bay, 40 miles up the coast from Corregidor. Deep water abounds there but the position has no defenses, and all supplies and material must be brought by sea from Manila.

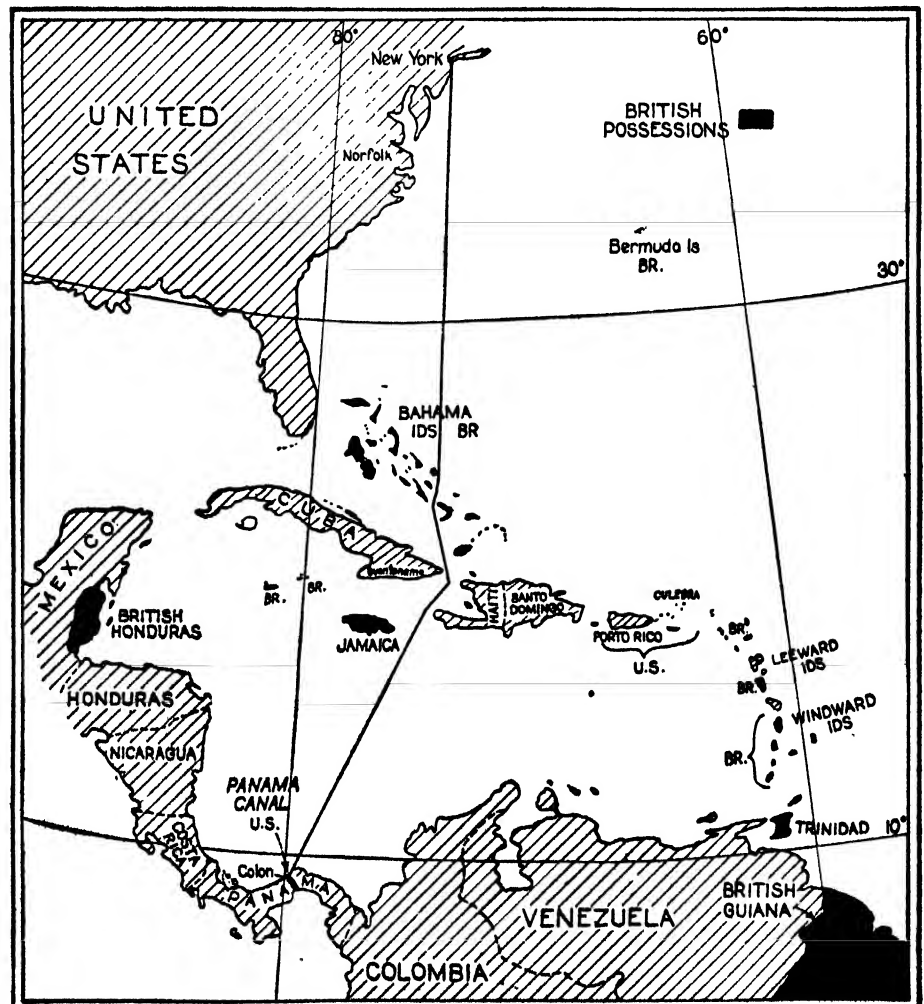
WE now begin to see what an effect the lack of bases, refueling and repair facilities have on the naval problem, especially where they are coupled with the vast distances that obtain in the Pacific, and again, something of what is required to constitute an adequate navy of ships. Not only does it take long periods of time and much fuel to go from port to port in this area but, due to lack of defended bases with ample resources from which to operate, lines of communication requiring many additional escort vessels, particularly of the cruiser and destroyer types, must be maintained.

Having determined somewhat the meaning of the term "adequate," we may also obtain an idea of what "comparative" naval strength means in this area, for, as we see by the map, our possessions in the Far East lie much closer to Japan, to outlying Japanese Islands, and to present British bases and sheltered harbors, than they do to

our nearest base in Hawaii, much less to the more adequate resources of our own coast.

It is common among naval strategists to refer to Guam as the "key to the western Pacific," as indeed it would be were it developed and fortified; but at present it is a source of weakness rather than of strength. Not only are the main Japanese islands less than 1500 miles from Manila, but Japan already had, at the time the status quo was established by the Washington treaties, numerous advanced bases of considerable value even nearer. She had an advanced base in the Pescadores Islands in the Formosa Channel, only 600 miles from Manila. This was fortified and had considerable area, supplies, fuel, and overhaul facilities for destroyers and small craft. She had advanced bases of some force at the anchorages at Amami and Okinawa, in the Loo Choo group northeast from Luzon and less than 1000 miles from Manila. Eight hundred and thirty miles north of Guam, and only 500-odd miles off her own coast, she had a valuable advanced base in the Bonin Islands.

Under the mandate provisions Japan controls the former German cable sta-



OUR LINE OF COMMUNICATION THROUGH THE PANAMA CANAL

There are many good harbors in the encircling curve of British possessions within easy striking distance of the Panama Canal and our supply and communication route to the Pacific

tion at Yap, and the Pelew Islands between Guam and the Southern Philippines; in the Caroline group, less than 600 miles away, she controls a sheltered anchorage at the atoll of Truk, capable of sheltering the fleets of the world. In the Marshall Islands, on the southern flank of the route to Guam, and on the way from Samoa to Guam or the Philippines, she controls extensive anchorages at Eniwetok, Rongelob Wotje, Jaluit, and Ponape.

HONG KONG, the British base in China already referred to, is only about 600 miles away and the new British base at Singapore is only some 1300 miles from Manila. British anchorages and harbors in the Fijis, and the Admiralty Islands along the route from Samoa to the Philippines, have already been mentioned. It may also be stated in passing that the only harbors near the route from the Panama Canal to Samoa are in the Marquesas, Tuamotu, and Society Islands, owned by the French.

From this brief survey it can be seen that a force adequate to cover this area for us must be considerable because of the long distances involved, and our lack of secure bases from which to refuel and operate; also that like numbers of ships would give not only the Japanese but the British as well, much greater comparative strength in this area than it would give us. This is especially true in view of the fact that the United States is prohibited by

treaty from establishing any secure base facilities in the Aleutian Islands or in Guam and, furthermore, is even prohibited from fortifying against siege operations any positions in the Philippines themselves.

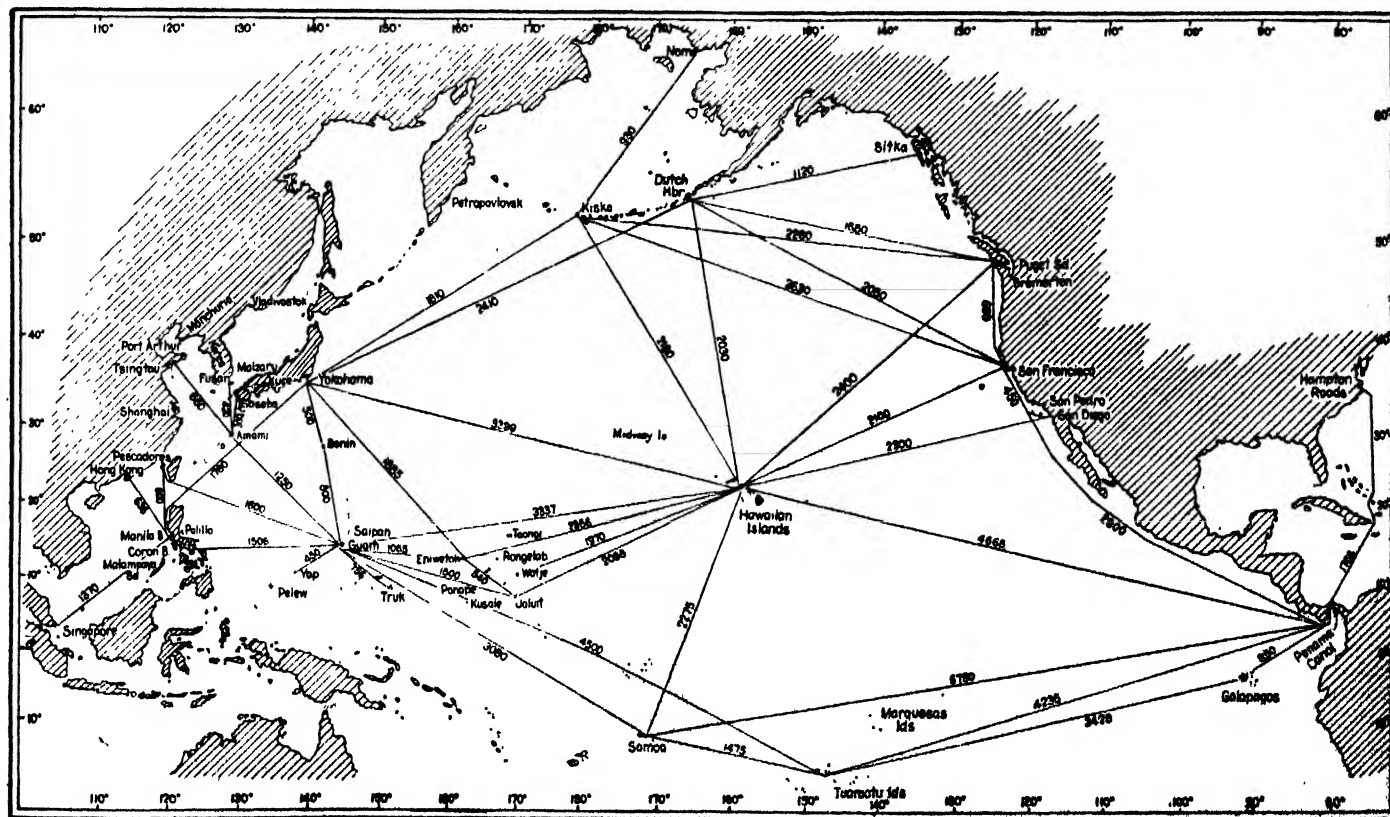
As an example of how adequate numbers multiply in comparison, Japanese vessels could steam at moderate cruiser or destroyer speed—let us say 20 knots—from their position in the Bonin Islands to Guam in 42 hours, or from their secure base in the Pescadores Islands to Manila in 30 hours. British vessels could cross from Hong Kong to Manila in the same time, or a British fleet could steam from Singapore in less than three days. For us, the distance from our nearest secure base at Pearl Harbor is so great that no vessels could cover it at high speed. Destroyers would have to be refueled en route unless they steam at their most economical speed of about 10 knots, which is quite too slow for military purposes. This indicates the great value of naval bases. Possession of these greatly increases the relative strength of a fleet; lack of them can be overcome, if at all, only by a numerically larger fleet.

Raiding Japanese or British forces could strike at our positions in Guam or the Philippines, return home, refuel, and be out again long before any help could come from our position in Hawaii. This is the same thing as increasing in relative numbers the British and Japanese fleets. The same is true were our fleet actually in the Philip-

pinas. It would have no secure base in which to lie or from which to operate and would have to defend and maintain itself; and to do this, a large portion of its effective strength would have to be employed defensively in attempting to maintain its own communications. This means that equal numbers of ships leaves the balance of power in the Philippines in the hands of either the Japanese or the British.

COMING nearer home it should be remembered that the Panama Canal is dependent upon our undisputed control of the sea in that area. Whatever force is detached to guard it or to secure our communications with it, weakens the fleet to that extent. The present British positions, previously referred to, increase the numbers that would have to be detailed for this purpose and reduce correspondingly the relative strength of our fleet.

It is the task of the navy to defend our overseas possessions and protect our essential trade routes. It is adequate only when it is strong enough to do this, or strong enough to make it too risky for others to interfere with our policies. By this study of geography we see what a large bearing the possession by others of naval bases and suitable harbors in our important areas, and our lack of these same facilities, has on the subject of naval strength insofar as it particularly concerns the United States.



STRATEGIC MAP OF THE PACIFIC

Slightly off scale due to flattening, this map shows the mileage between important Pacific ports. The weakness of the United States in

this area can be noted by following on the map the facts brought out by the author. Further development of bases is prohibited by treaty

has been dipped in the special flux, is then applied and melted into the joint by means of the torch. It is said to give an extremely strong joint that may be machined easily, and is not bulky.

The specific feature of this method is that it offers new economies for designing and production engineers to whom it would never occur otherwise to specify cast iron fittings for a steel unit. Cast iron fittings are, of course, less expensive than steel fittings but a way to weld them had not been thought practical hitherto.

Largest Molten Metal Transport Car

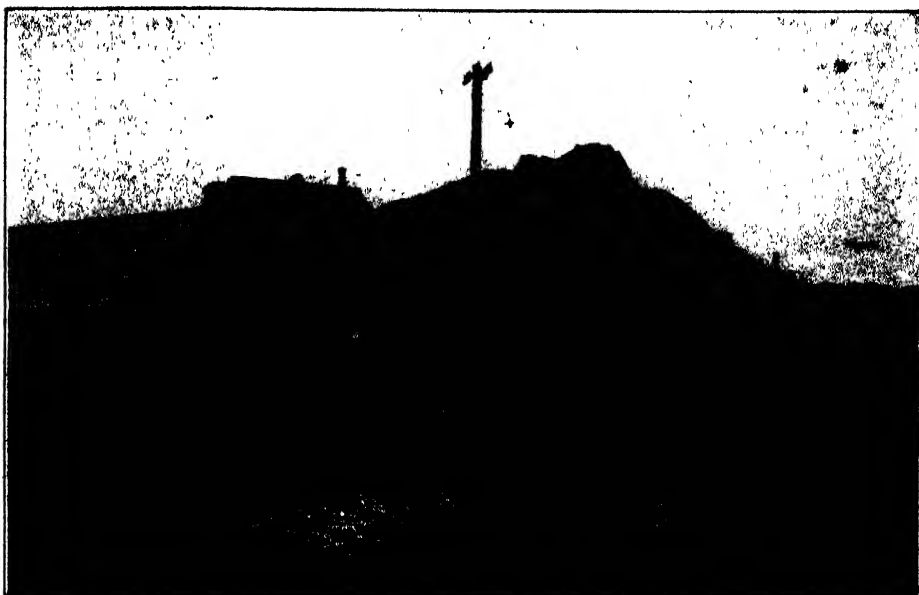
UNDER an arrangement between the Hamilton Coke and Iron Company and the American Rolling Mill Company, the former has rebuilt and enlarged its furnaces on the northerly edge of Hamilton, Ohio,



The joint bronze-welded by the new method is said to be neat, strong, and machinable when necessary

and will supply molten iron to the rolling mill at Middletown, Ohio. The Baltimore and Ohio Railroad did its share in making the plan practicable by building a 10-mile special road between the two plants.

The building of the road was a major job inasmuch as it was necessary to build all



P and A

One of the fire-brick lined ladle cars that transport molten metal over a special road of the Baltimore and Ohio Railroad between Hamilton and Middletown, Ohio. When loaded with molten metal, each huge ladle car weighs 340 tons

bridges of much greater strength than any hitherto built in order to take care of the extremely heavy loads. The bridge over the Miami River, for example, was designed for a 50 percent greater capacity than any other ever built. The three ladle cars, to be used on this road, are by far the largest ever constructed for such a purpose.

In these cars, molten metal will be carried daily between the two plants, two and one half hours being required for a round trip, and the average being four trips in 24 hours. The length of these cars is about 56 feet. They have four axles at each end or a total of sixteen wheels and, when loaded with molten iron, they weigh 685,000 pounds, or 340 tons. The cars are lined with fire brick and provided with lids something like a giant thermos bottle. The molten metal is poured into them at the furnace and after movement to the rolling mill, they are tilted so that the metal runs out like so much water. This is accomplished by having the ladle which carries the iron, on pivots. The tilting is done electrically and safety is provided by arrangements which permit the electrical attachment to be made only when the car is at a standstill.

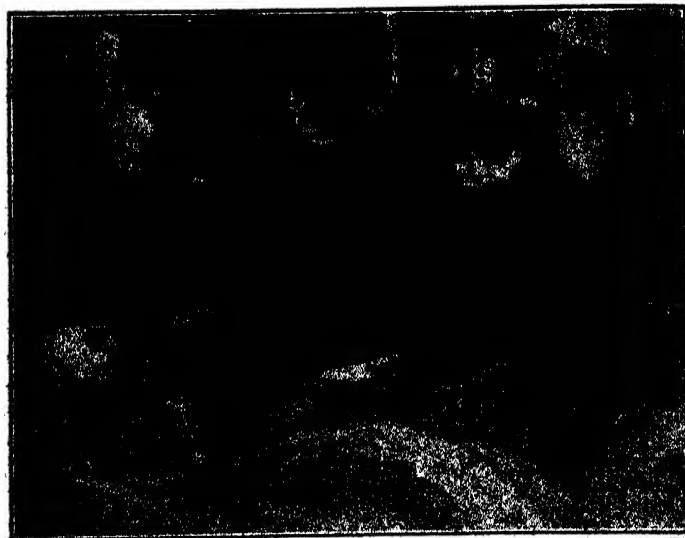
The molten metal can, when necessary, be held in the ladle 48 hours. The capacity of these ladles is 150 tons each.

Noiseless Street Cars

MUCH has been written, especially in letters to the press, regarding the ever increasing noise in our cities, the clang and clatter of machinery and vehicles; and some attempts, more or less productive of results, have been made to muffle or minimize these noises. A noteworthy attempt recently brought to our attention is that of the Market Street Railway Company of San Francisco. This railway had adopted a program for cutting down the clang and clatter of rolling stock and lessening the pounding of cars on the street roadbed.

Already six street cars, 1928 model, which make much less noise than any equally large cars operated in San Francisco at the present, are in operation on the tracks of this company. The clang of these cars is deadened by the use of lead in grooves cut in the inside of the rims of gears; drumming sounds are cut down by

(Please turn to page 271)



In silencing the street cars in San Francisco, rubber pads were inserted between the trucks and the car body



The clang of gears was cut down by cutting a groove inside the gear rim and pouring melted lead into this

Learning to Use Our Wings

This Department Will Keep Our Readers Informed of the Latest Facts About Airplanes and Airships

CONDUCTED BY ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York City

A Net of Weather Stations

WHEN the operations of the air mail lines were taken over by private companies, the Airways Division of the Department of Commerce undertook the duty of supplying weather information to pilots. The number of weather reporting stations has been increased rapidly. These stations have been placed as strings roughly paralleling the airways.

Dr. C. G. Rossby, in a paper before the American Society of Mechanical Engineers, suggests that such strings are insufficient

compensated for by greater safety and reliability, which in turn will entail greater patronage.

The Daniel Guggenheim Fund for the Promotion of Aeronautics has established such a network on an experimental basis between San Francisco and Los Angeles, where the main obstacles to flying are fog, low clouds and poor visibility.

It is interesting to note how this service works. Three observations are made daily—at 9.30 A.M., 11 A.M. and 12.30 P.M.—covering the part of the day during which most flying is done. The collection and exchange of these weather reports is handled exclusively by telephone. At each terminal, Oakland and Los Angeles, a sequence call, containing the telephone numbers of the various field stations, is filed with the local-long-distance exchanges, and the station is connected with various other stations in succession.

All observers are instructed to wait at their telephones at the report hours and give their reports in standardized terms as soon as the line is clear. While Oakland talks with Modesto, the long distance operator in Oakland is busy hooking up a line to Fresno, thus reducing the time between calls to a minimum. The telephone service has already proved highly efficient, and much progress may be hoped from such weather nets and telephone service.

The Bellanca Sesquiplane

BELLANCA is undoubtedly one of our most original designers, and his latest plane presents many novel and original features.

It has been built for Cesare Sabelli, for a proposed flight from New York to Rome, and will have the great range of approximately 5500 miles—perhaps the greatest airplane range on record. The main characteristics are as follows: length over all, 39 feet one inch; height, 11 feet six inches; span of upper wing, 64 feet six inches; span of lower wing, 36 feet eight inches; wing area, 606 square feet; power plant, Pratt and Whitney Hornet of 500

horsepower; weight empty with normal equipment, 4000 pounds; useful load, 6000 to 8000 pounds; gasoline capacity, 1000 gallons; high speed, 140 miles per hour; range, 5500 miles.

There is little doubt that these estimates of performance will be realized because of two important factors. The first of these is the skill with which the structural weight has been kept down. It is remarkable that the weight empty should be only one third of the gross weight. The second is the extreme aerodynamic refinement of the design.

The Bellanca model K, as it is termed, is a sesquiplane. We are not quite sure that this designation is linguistically correct, but sesquiplane has come to mean a plane and a half, a cross between a monoplane and a biplane, with the larger wing generally the upper one.

Since a monoplane is always more efficient aerodynamically than a biplane, it may be asked why Bellanca has departed from his usual monoplane practice. The answer is that this sesquiplane design lends itself particularly well to the incorporation of a retractable chassis. The lower, thick wing is brought downwards from the body at a negative dihedral, to put it technically, so that its tip is comparatively near the ground. The supporting struts of the landing gear, placed at the tip of the lower wing, are therefore very short.

The thick, stub-like wing also serves to house the wheels in their retracted position. The landing gear of an airplane may have half the air resistance of the entire fuselage. The greater part of this resistance lies in the large wheels. Therefore, from a performance point of view, it is well worth while to withdraw the chassis while in flight. It is quite certain that many commercial designs will follow with retractable chassis.

The only drawbacks to retractable chassis are: the possibility that an absent-minded aviator may forget to extend the chassis when alighting, and the mechanical complication involved. There are several

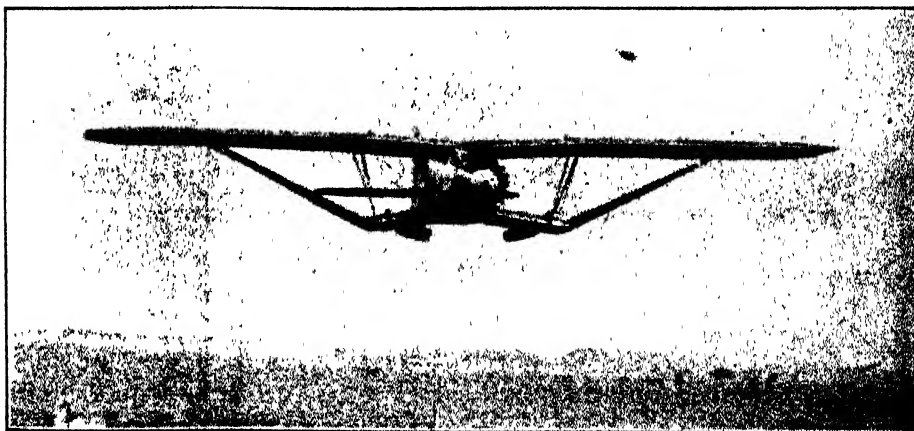


Of course you all know who these folks are, but their picture belongs with the rest of the aviation news. In the center: Amelia Earhart, first woman transatlantic flyer; left, Louis Gordon, mechanic; and right, Wilmer Stultz, pilot

and that what is needed is a dense network of stations on and surrounding the airway.

Especially in summer time, local disturbances, such as thunderstorms, may drift with the wind across the course and come as a complete surprise to the aviator, even if the "string" of weather stations has done its best to keep him informed. To a certain extent, if a network of weather stations were established, the aviator could, in emergencies, play hide and seek with the weather, and depart from the airway under certain conditions.

The extra cost of such comprehensive meteorological service will be more than



Bellanca sesquiplane Roma, in flight with wheels retracted

instances on record of aviators who have landed amphibians on dry land with chassis withdrawn, but the procedure is not necessarily fatal, and the mechanical complications are not so very great.

The landing gear wheels are each supported by two steel members, both on the inner side of the wheel. The forward member is almost vertical, being slightly bent to bring the wheel farther forward. The front strut is mounted through a shock-absorber mechanism to the forward spar of the lower wing. The rear member is mounted on a ball and socket joint at the rear spar. The two vertical struts are prevented from side motion by two heavy tubes, one on each side. To retract the landing gear, the bracing tubes on each side are drawn back towards the trailing edge, and steel cables simultaneously draw the wheels into the wing as they swing about the rear ball and socket joint.

Another aerodynamic refinement, which Bellanca has already used in the past, is in the outer struts which go from the tip of the lower wing to a point in the upper wing. These are of airfoil section, and have about two thirds the lift of an ordinary wing, in proportion to their area. Since there must be struts for bracing, why not make them do some work in lifting, instead of acting as purely resistance producing elements?

The sesquiplane carries 1000 gallons of fuel, of which 600 gallons are carried in the fuselage behind the pilot. Behind this fuel compartment are housed the navigator and the radio man, with all the instruments that the hearts of long-distance flyers can desire.

The remaining 400 gallons of gas is housed by Bellanca in the upper wing. He has answered, in these tanks, another very logical question. Why not make the wing structure itself be the gas tank? The entire inner bay of the upper wing is indeed a gas tank. Upper and lower wing coverings are made with liquid tight seams. The spars are of dural, perforated with holes to permit the gasoline to flow freely from



Wide World

The Roma, with tail up, taking off from Roosevelt Field, New York

front to rear of the tanks. The ribs, with holes top and bottom, act as anti-splash plates. The combination of tank and wing weighs far less than would a wing with separate tank.

Wheels and Brakes

THE airplane is by far the most refined vehicle of transportation. Even in such items as wheels, it leads in lightness and strength of construction. Brakes, which were at first opposed even by the experienced operators of the air mail service, are now almost universally employed.

The Bendix-Laddon wheel, shown in one of our photographs, is built entirely of duralumin. It has as perfect a streamline as it is possible to give a wheel. It is en-

tirely watertight. A 32-inch by six-inch wheel, complete with brake weighs only 28 pounds, yet it has a radial strength of 10 tons!

Another photograph shows the brake mechanism and its housing, just as it is to be put into the wheel. The brake is of the well known two-shoe Servo type, which has proved so useful in the automobile. The



A streamlined airplane wheel, with brake, built of duralumin

cam to apply the first shoe is turned in the same direction as the rotation of the wheel when the plane is traveling in a forward direction. The friction between the wheel and the brake band then serves to bring the second brake into action by a system of linkages. Thus the brake is self-energizing and requires a minimum of effort for its operation.

The mounting of the brake control system is quite an engineering problem. Our diagram shows a typical installation, with



Wide World

Front end of the Roma, showing pilots' cockpit enclosed, and the powerful radial engine in the nose. Cesare Sabelli, pilot, is shown at the controls

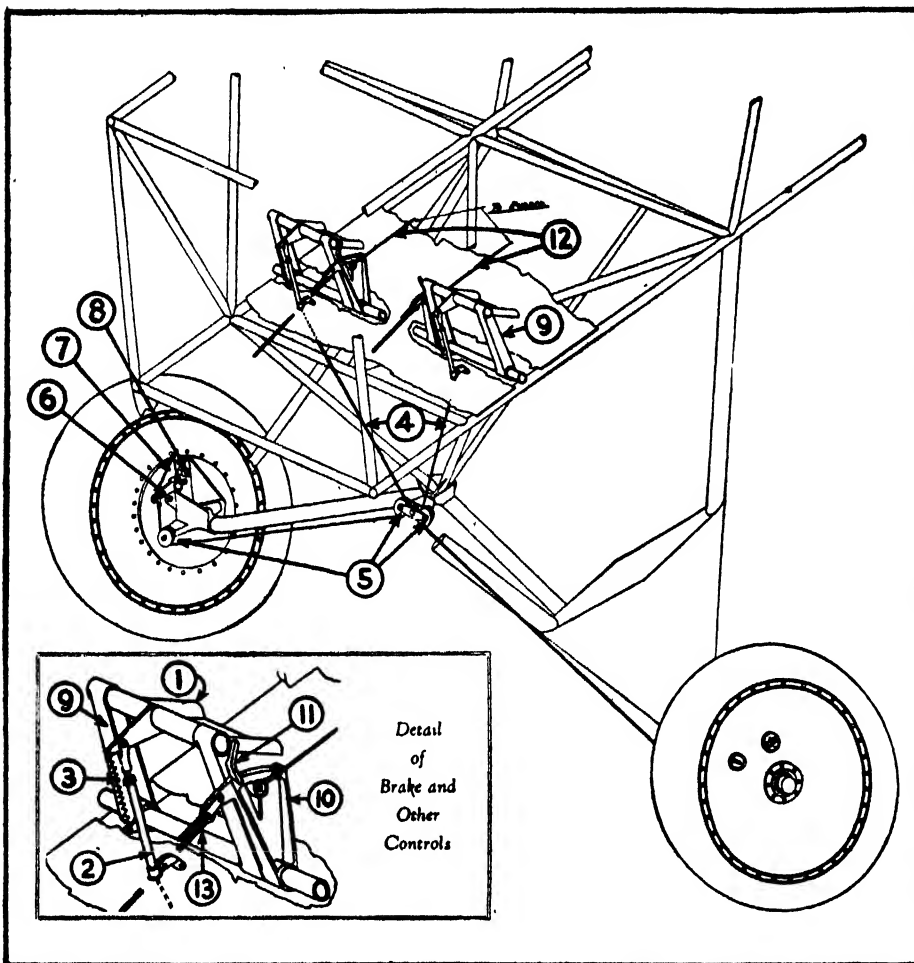


Diagram of airplane wheel-brake installation

the numbers showing the most important parts.

The brake control pad, 1, is mounted on the rudder pedal 9. The control pad return spring, 3, always returns the brake pad to its normal position, when it is released by the pilot. Part 2 is the parallel action link to which the cable is attached. The brake control cables, 4, pass over pulleys 5, to the brake actuating lever 6, which serves to turn the cam that actuates the internal mechanism shown in our photograph. The rudder pedal can be adjusted by a pawl, 11. An elastic, 13, serves as a pedal return.

For a while the rocket was considered as a military weapon, but the rapid-fire three-inch gun and the Stokes mortar put an end to this idea.

As to the actual mechanical principles of the rocket, but little is understood even to this day. The rocket works on the reaction principle, the reaction being between the gases of combustion and the chamber in which they are contained. It does not work by reaction between the gases and the air, as might at first be supposed. In fact Professor Goddard, who has devoted so much time to the problem, has shown that a

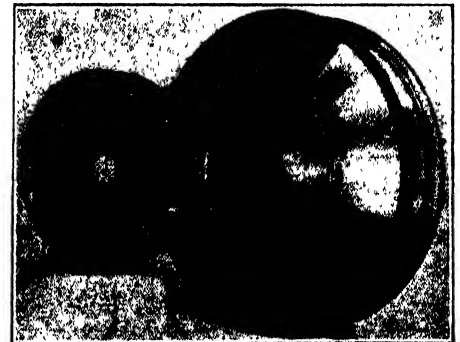
rocket moves faster in a vacuum than it does in air.

The ordinary pyrotechnical rocket is very inefficient because, since it is made of paper, its chamber cannot work with a high pressure; and it is the pressure in the rocket which determines the velocity of efflux of the gases, which, in turn, determines the efficiency of the device. Because of this, the velocity of the flow of gases in an ordinary rocket is only of the order of 1000 feet per second, and the efficiency scarcely more than 2 percent. With steel-chamber rockets, velocities of the order of 7000 feet per second become possible, and much higher efficiencies may be expected.

The shape of the rocket has a great deal to do with its efficiency. The best results seem to be obtained with a chamber which is not cylindrical, but which expands towards the exit somewhat like a De Laval turbine nozzle. The composition of the powder and its rate of explosion also have a good deal to do with efficiency.

So much for the general principles of the rocket. Now, why should a rocket be applied to locomotion purposes? Certainly not on economic grounds. Gunpowder seems to have enormous energy, and yet a pound of gunpowder gives only one tenth the energy that a pound of gasoline or alcohol will give.

Gunpowder has only one advantage. It contains within itself the oxygen needed



Airplane wheel-brake mechanism of the self-energizing type

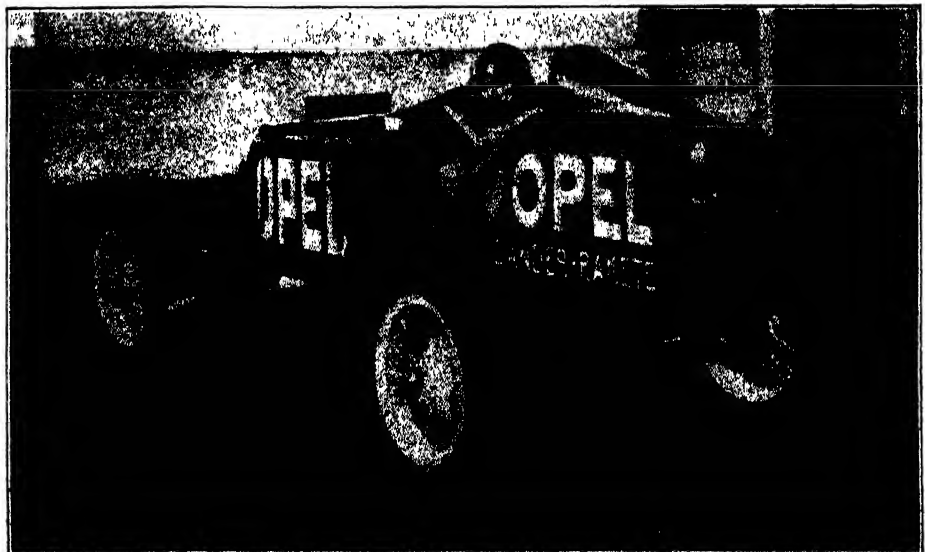
for combustion. With gasoline or other fuel, we must have a mechanism in which air is mixed with the fuel, compressed, and
(Please turn to page 275)

Can There Be a Rocket Airplane?

FOR many years, interstellar navigation by means of rocket-propelled cylinders has been a subject of discussion and some experimentation. The recent German experiments with rocket propelled cars and gliders have attracted much attention, and it is now asked whether rocket-driven airplanes are not possible, navigating at fantastic speeds. It is impossible at this early stage of development to venture a definite opinion. But it may be of interest to our readers to review the various principles involved.

In the *Journal of the American Society of Mechanical Engineers*, we find some useful primary information on the rocket.

The Chinese, who are supposed to have invented gunpowder, have long used it for celebrations. The rocket began in the same way, as a pyrotechnical device. At a later date, its great visibility led to its employment for purposes of signaling as in the Coston ship rocket, the use of which has now developed into an elaborate technique.



Wide World

The rocket automobile using the same method of propulsion as is discussed for airplanes in these columns. The steel tubes protruding from the rear end are part of the rockets, which are to be ignited consecutively by the driver

This grainless wood is workable almost beyond belief!

Can be cut out, punched, die cut and milled. Very dense and tough. Highly resistive to moisture. Has a smooth, attractive surface on the face side, and requires no paint for protection. Also takes any finish beautifully. Send for large free sample.



FOR STORE FIXTURES

American Industry is now pretty well aware of the fact that there is on the market a genuine all-wood board that is *grainless*, that won't crack, split or splinter, and that is highly resistive to moisture.

But there are still many manufacturers and mechanics who do not fully appreciate the truly remarkable workability of Masonite Presdwood.

Containing absolutely no foreign substance of any kind, Presdwood cannot damage tools. It can be used on saw, planer, sander, shaper. It can be cut out, milled, die cut and punched. It also assures economy in cutting panels to size. In fact, it practically eliminates all waste in cutting.

Presdwood has uniform strength, too. It is highly resistive to moisture. It is very dense and tough. It has a smooth attractive surface on the face side, requires no paint for protection, and takes any finish beautifully.

Wide, wide range of uses

Although it has been on the market only two years, Masonite Presdwood is already in use in scores of industries all over the country.

Presdwood is used extensively in paneling—alike in fine Southern homes, in stores and offices of the East and the Middle West, and in summer cottages of the great North woods.

It is being used in the manufacture of kitchen cabinets, medicine chests, cupboards, tension boards, work-bench tops, tables, desks, book cases, linen chests and china closets.

Toy manufacturers are large users of Presdwood. It is serving in hospitals as bedroom screens and as

invalid trays. And it is especially efficient for table tops.

Laundries, bakeries and dairies are using Presdwood quite extensively. For example, it goes into the making of clothes hampers. And because of its strength and resistance to moisture, it is being built into bread boxes and patented dairy containers.

A number of Chicago railroads are using Presdwood as dust arresters for journal boxes; various foundries are finding it an ideal material for cooling trays for hot castings; it is also going in to the production of packing cases.

New and unexpected uses

Just recently a manufacturer of portable billiard tables became interested in Presdwood. He is especially impressed by its stout resistance to wear.

A manufacturer of electric light globes is putting Presdwood to a novel use. He bores holes into it to fit his bulbs, and thus they are held tightly while being etched.

Presdwood is also being used to line ventilators and elevator shafts—because of its excellent anti-rattle qualities.

And before this advertisement reaches your eye a number of other Presdwood uses will have been discovered—some of them entirely unexpected uses.

Write today for a large free sample of Presdwood and find out what it will do for you.



FOR PANELING

FOR SIGNS

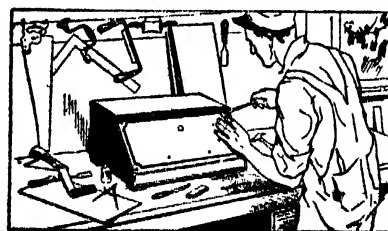


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Mfg. Laurel, Mississippi

Masonite
PRESWOOD
Made by the makers of
MASONITE STRUCTURAL INSULATION

FOR RADIO CABINETS



Industries From Atoms

A Department Devoted to the Advancements Made in Industrial and Experimental Chemistry

The Chemistry of Faded Colors

EVERYONE has experienced the shock of finding that the color has faded when a picture is taken from its usual position over the wall paper or when the hem of sister's dress is let down to make it "do" for a while longer. Light has two different effects on dyed fabrics—the color of the material fades or changes hue and the material itself loses strength. Recently, chemists have investigated the causes of these effects with interest stimulated by two new developments, the increasing use of indanthrene dyes and of rayon.

Two theories have been advanced to explain the fading action of light. The "oxidation theory" assumes that the dye stuff is destroyed, directly or indirectly, by the oxygen of the air. The second theory explains the destruction of the dyestuff by the reverse process—that is, the "reduction" of the dyestuff. This "reduction" means the abstraction of oxygen, or the addition ultimately of hydrogen, the dyestuff being in either case converted into colorless or lighter colored substances.

In experiments to isolate and identify the actual products of fading, a pure crystalline substance that proved to be isatin, was obtained. Isatin is an oxidation product of indigo, so that it seems to give proof that the fading of indigo-dyed cotton is a result of oxidation. Other experiments give some evidence that in the case of simple azo dyes, fading is also due to oxidation.

In studying the loss of strength due to the action of light, experiments show that the effect is more marked with some colors, such as orange and yellow, than in the blues and violets.

In the case of the tendering of rayon there seems to be little doubt but that the immediate cause is oxidation of the cellulose as the formation of "oxy-cellulose" can be shown by the usual tests.

Causes of Defects in Canned Foods

PROFESSIONAL humorists assure us that the truly utilitarian gift for the bride today is not a cook book but a can-

opener. Such an insinuation, even if true, does not necessarily condemn the modern bride's culinary production, for some mighty tasty food comes in a tinned-iron wrapper nowadays. Yet, in spite of the tireless efforts of the canners to produce perfect foods, certain defects occasionally mar their appearance, some of which are explained as follows by the National Canners Association:

"The coloring matter in the outer coating of some varieties of beans forms a combination with iron which has a dark purple, almost black, color. Special precautions for the canning of such products is necessary. One canner who packs a variety of string beans the seeds of which are slightly colored found that in his canned products the seeds had taken on such a dark color that they showed through the hull, presenting an undesirable appearance. Investigation revealed that he was using a process that was unnecessarily long, and shortening it to the proper length eliminated the dark color.

"Beets are sometimes canned whole and sometimes after slicing. Discoloration has occurred at the center of the sliced beets. This was found to be due to allowing them to stand too long after slicing before they were canned. Under these conditions an enzyme at the center of the beet, which had not been destroyed in blanching, produced a marked darkening. This was eliminated by prompt canning after slicing.

"Ketchup sometimes shows a black band in the neck of the bottle next to the cork. This has been found to be due to a leak in the closure sufficient to admit air but not large enough to admit bacteria and produce spoilage.

"Canned okra sometimes shows a black discoloration on the cut ends of the pieces. This has been found to be due to the use of iron knives for cutting the product.

"Black spots of iron sulfide have occurred in salmon cans, and discolored the salmon and the liquid. These were found to be associated with loose seams and paper gaskets.

"Somewhat similar to these difficulties

with regard to discoloration are the complaints that broken glass had been found in salmon, crab and shrimp. Whenever investigated, however, the glass-like particles proved to be crystals of magnesium ammonium phosphate, a harmless substance occurring naturally in these products but only forming visible crystals under certain conditions such as extremely slow cooling."

Instrument Analyzes Color

WHEN we are asked to define a color, the answer seems relatively simple if we have a shade in which one of the primary colors such as blue or red strongly predominates, but it becomes more difficult when there is no predominating primary, or when the latter is mixed with a considerable quantity of its complement. Rene Toussaint, writing in *The Paper Industry*, describes the use of a photo-electric cell for analyzing color with scientific precision.

"Color is the resultant of an indefinite number of radiations or shades, each of definite intensity. The intensity or tone of a color indicates the place it occupies on a scale extending from white to black, while its shade or radiation indicates its position on the chromatic scale extending from red to violet.

"A color can therefore be represented in a very simple manner by a curve analogous to a musical staff, in which the abscissas are the shades (expressed in terms of wavelengths) while the ordinates are the luminous intensities. In order to construct such curves, it is sufficient in practice to determine the luminous intensity for the mean wavelength of the six standard zones of the solar spectrum (red, orange, yellow, green, blue, violet). The curve of any color is thus determined by means of six points. The luminous intensity in each case is expressed as the percent of the amount of the same radiation present in a standard white; and the higher the value found the more intense and luminous is that particular shade in the color under consideration.

"In order to be able to analyze and measure colors with accuracy and certainty, it



These two views were taken in the Du Pont plant in Buffalo where rayon is manufactured. The wide-spread use of this comparatively new textile has stimulated



research as to the cause of fading colors. Some interesting results of the experiments with dyed goods which have been conducted are outlined in the text above

PUBLIC APPROVAL

... is revealed in
the most concrete
and convincing
way by sales ...

A BUYER'S name on the dotted line of an order blank is high praise—sincere, conclusive, convincing.

And careful buyers, thousands of them, are purchasing these 6 cylinder Graham Brothers Trucks—enthusiastic over their smooth, obedient power, proud of their fine appearance, surprised at the speed obtainable with perfect safety because of their 4-wheel brakes

Claims, promises and ballyhoo are crushed under the weight of purchasers' dollars.

See these trucks Drive the size that fits your business needs—they are built in the sizes that fit 95% of all hauling or delivery requirements.

Ask your local Dodge Brothers Dealer to demonstrate. You will see *why* truck operators everywhere are buying—*why* deliveries are being made at the rate of more than 300 a day.

***665**
MERCHANTS EXPRESS
110" wheelbase

***775**
COMMERCIAL TRUCK
120" wheelbase

***995**
1¼-TON—130" wheelbase

***1065**
1¼-TON—140" wheelbase

***1345**
1¼-TON—150" wheelbase

***1415**
1¼-TON—165" wheelbase

***1595**
2½-TON—150" wheelbase

***1665**
2½-TON—165" wheelbase

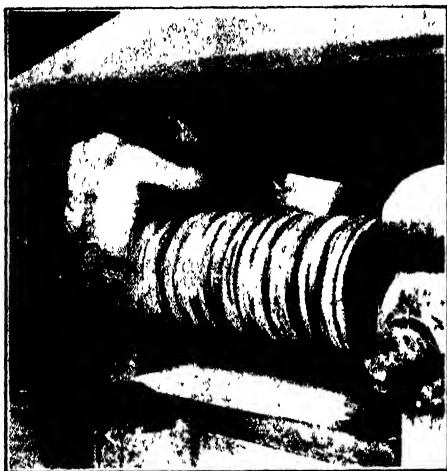
Chassis f. o. b. Detroit

GRAHAM BROTHERS TRUCKS

BUILT BY
TRUCK DIVISION OF
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SOLD AND SERVICED
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DEALERS EVERYWHERE

is necessary to replace the eye by some reliable device. Such is the photo-electric cell in the form which has been developed by the Société de Recherches et Perfectionnements Industriels, of Paris. It consists of a glass bulb coated inside with metallic potassium, which acts as cathode, and containing a tungsten ring which acts



Kneading rubber in a mixing mill, to incorporate the ingredients

as anode. The cell is inserted in a circuit comprising a 120-volt battery and a galvanometer. When a beam of light falls on the cell, the potassium gives off electrons which vary the conductivity of the cell and consequently the intensity of the current flowing through the circuit. As the current is proportional to the light energy received by the cell, the galvanometer gives an absolute measure of the quantity of light received and acts as a photometer.

"The operation of the instrument is quite simple. Light from a suitable source (preferably a Philipps 'Pintolite' lamp, in which an arc is struck between two two-millimeter tungsten spheres,) is first passed through a condenser to concentrate the rays and is then directed on to the sample, from which it is reflected on to the photo-electric cell, causing an immediate variation in the current flowing through the galvanometer.

"In order to construct the curve of any given color, six color screens (violet, blue, green, yellow, orange, and red), are interposed successively between the condenser and the sample stand, and two readings are taken with each screen, one with the sample and one with the standard.

"We have already seen that the curve of any given color is determined by means of six points giving the value or intensity of the violet, blue, green, yellow, orange, and red entering into its composition. In order to determine these six points, readings are taken on the sample and on the standard with each of the monochromatic filters previously mentioned, and the ratio between the two readings is calculated for each color."

Among the applications of the instrument may be cited matching colors, measuring gloss and transparency, testing and comparing dyes, preparing dyeing formulas, et cetera.

Water Dispersions of Rubber Find Wide Application

A MAGICIAN friend of mine, who is also something of a chemist, is fond of explaining that the way he is able to re-

store the paper napkin previously torn into fragments is by using a specially made paper in which rubber is added to the fiber during manufacture. This "explanation" from my nimble-fingered friend's "patter" has never seemed quite as satisfactory to me as my own private suspicion that he substitutes a duplicate napkin by some hokus pokus of legerdemain. But recently there have come into prominence such promising developments in the applications of water dispersions of rubber that it begins to look as though rubber technologists may soon accomplish tricks of their own which will find widespread commercial application.

Attempts to use the sap of the rubber tree (known as latex) in its original liquid form date back to the beginning of the rubber industry itself, but its industrial applications have been limited. Recently, however, chemists have devised methods of producing what amounts to a synthetic latex by dispersing crude or re-claimed rubber in water by treating it in a suitable mixer in the presence of a hydrophilic colloid.

Hydrophilic colloids have a peptizing action which reduces the interfacial tension between the rubber particles so that they no longer adhere to each other but become dispersed. Some of the available dispersing agents are fatty acids and their salts, resin acids, glues, saponins, albumins, caseins, and colloidal clays.

Among the commercial applications of dispersed rubber may be mentioned its use in the manufacture of automobile top material instead of the usual rubber cement; in the backing of rugs, carpets, mats, et cetera; and in the manufacture of raincoats, cloth bags and sacks for shipments which must be kept dry. Paper impregnated with aqueous dispersions shows increased tensile strength, resistance to tear, flexibility, and water-resisting

properties. Dispersed rubber is being used in the canning industry for sealing the seams of tin containers.

H. A. Winkelmann, writing in *India Rubber World*, predicts that the development of aqueous dispersions will rank in importance with such contributions to rubber technology as accelerators, antioxidants, anode rubber, et cetera, and that rubber in this new form will find useful applications in many other fields.

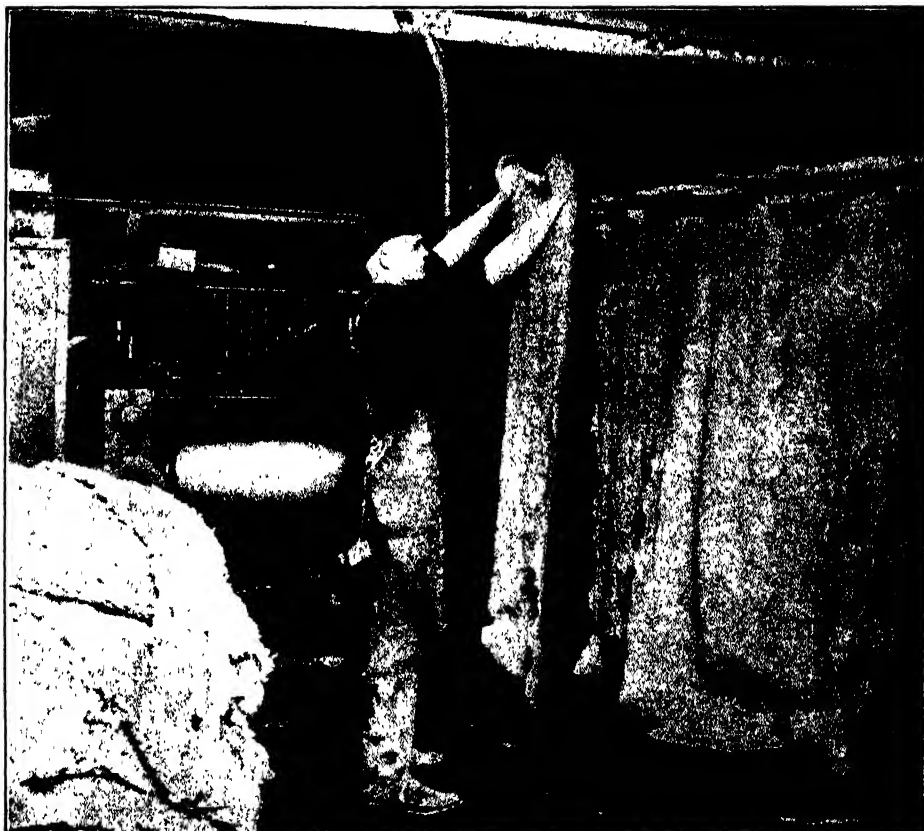
New Tires for Old

WHEN the garage man shakes his head mournfully over a thoroughly deflated "flat" and remarks, "I might be able to fix it, but it won't last," the average motorist loses all interest in the career of that particular piece of rubber. Not so, however, the rubber reclaim man, who sees in the unprepossessing erstwhile "shoe," raw material for his industry, which supplies millions of pounds of reclaimed rubber to the rubber industry. Formerly designated by the derogatory name "shoddy," reclaimed rubber has come to be a vital factor in the industry, and a thoroughly reputable ingredient of the best tires.

The old tires are sorted and suitably blended, ground to size, and digested at high pressures with caustic solution to destroy the cotton fabric. Next the digested stock is washed and dewatered, then dried, milled, and refined. The reclaiming process is a refined chemical industry in itself, and one which has been greatly improved and developed in recent years. Most of this improvement has been confined, however, to the development of more efficient manufacturing apparatus, rather than to any fundamental changes in the method of recovering the rubber.

Paul S. Shoaff, of the Goodyear Tire and Rubber Company, one of the leading

(Please turn to page 279)



The final step in the milling process in rubber manufacture. The sheets of crude rubber that are being hung up on the rack are known as crepe rubber



Boston Massacre

"Fire if you dare, fire and be damned!" An icy snowball thudded against Captain Preston's well-tailored ribs. Trembling with rage, he cautioned his men: "Hold your peace!" A group of shivering idlers on the Boston street rapidly became a mob.

The mob pressed closer. "Lobster-backs!" jeered one Crispus Attucks, coffee-hued blackamoor. Then cat-calls, vile and insulting epithets, followed by a volley of hard-packed snowballs, some rock-pitted.

The Redcoats made little noises with their guns. "Hold your peace!" cried Captain Preston. They did; but the mob, now one great stupid animal, got louder, and the big-lipped Negro bolder. Soon he found a smooth pine board, raised it, thwacked a soldier's rump. The Redcoat turned, point-blanked his musket in Attucks' face. Spit! Flash! Crack! Negro Attucks screeched, fell dead. Other muskets spat and flashed. The mob recoiled in panic, leaving a sprawl of bodies (five starkly stiff) in the street. Blood oozed on the dirty snow. The soldiers, now ashamed, stood quiet. Captain Preston walked down the line, struck up their guns.

But it was too late to pretend that Massa-

chusetts had not defied its King. Drums beat, bells tolled, more Redcoats issued from the barracks.

"The Governor! The Governor!" . . . Acting-Governor Hutchison, white face set in hard lines, shouldered through the mob. "Captain Preston, what means this?" he thundered. "Consider yourself and your men under arrest, sir." To the mob: "Disperse at once, to your homes." . . .

So, in part, *TIME* would have reported the Boston Massacre of March 5, 1770, under the reign of King George III. Nor would *TIME* have omitted the events aggravating the affray—the townsmen's just resentment at the presence of two British regiments in the free capital of a loyal province, their just rage at having to pay for Redcoat board and keep.

So, too, would *TIME* have reported the turbulent mass-meeting of the day after: how Samuel Adams, popular emissary, forced Acting-Governor Hutchison to withdraw the troops to Castle William in the harbor. *TIME* would have stressed the subsequent trial of Captain Preston and his men; how Josiah Quincy and John Adams, patriots both, astute lawyers, defended the soldiers, that even-handed justice might be done.

Cultivated Americans, impatient with cheap sensationalism and windy bias, turn increasingly to publications edited in the historical spirit. These publications, fair-dealing, vigorously impartial, devote themselves to the public weal in the sense that they report what they see, serve no masters, fear no groups.



TIME

The Weekly Newsmagazine

NEW YORK CHICAGO

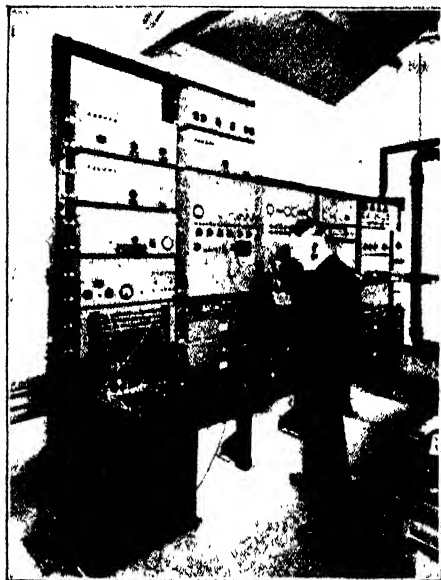


Strays From the Ether

A Monthly Review of the Progress Made In All Branches of Radio Communication

Instrument Tests Radio Reproducers

STUDY of such devices as radio loudspeakers on the basis of the sound waves that come to the listener's ear is now possible with an instrument invented by Dr. Dayton C. Miller, of Case School of Applied Science, Cleveland. At a meeting of the



Experiments are being conducted at English and Canadian beam radio stations with a system by which one telephone and two telegraph communications can be carried on over the same wavelength. Part of the equipment used is shown here

American Physical Society held recently, Dr. Miller described this new use of his apparatus, which he calls the "phonodeik." He made the experiments in conjunction with John R. Martin.

The phonodeik makes a photographic record of the sound wave as it is received by the ear. Dr. Miller's method is to connect the loudspeaker undergoing test to a microphone, then to record the output on the phonodeik. A similar record can be made of the original sound, and by comparing the two, the characteristics of the speaker determined. When a vacuum-tube voltmeter is substituted for the speaker, the experimenter can determine how much distortion is introduced by the electrical system, and can make allowances for it.—*Science Service.*

Grid-Suppressor Value

MANY radio enthusiasts considering the grid-suppressor method of stabilizing tuned radio-frequency circuits, are apt to hesitate because they are uncertain of the resistance value to employ. Resistance values anywhere from 200 to 3600 ohms are now being used with standard -01-A type tubes in typical tuned radio-frequency circuits. Yet tests show that the resistance value is not critical. From 600 to 800 ohms will usually be found about right when using the -01-A type tube and

in the conventional tuned radio-frequency circuit with a plate voltage not exceeding 90. For precise results, of course, it is worth experimenting with higher and lower values of resistance.

The main factor, however, is to avoid inductive resistance. Many types of resistances which will perform well in plate-voltage regulation and other applications, will be found unsatisfactory as grid suppressors. It is also important to guard against capacity effects within the grid suppressor. The latest types of metallized grid suppressor, available in resistance values from 100 to 800 ohms, fulfills the non-inductive and non-capacitative requirements, along with that for silent operation.

Resistance Coupling Essential in Television

WHILE the usual amplifier as now employed for broadcast reception may be utilized in experimental television, the pronounced peaks, together with the limited frequency response of most transformer-coupled amplifiers, will produce distorted television images.

"We all recall the early amplifiers which operated our first loudspeakers," states Mr. Ehle, president of the International Resistance Company. "Because of the novelty of radio in those days, more or less distortion made little difference. It must be much the same with television. In the first thrilling days of experimental television, even the mere outline of a man or

hand or other object will suffice, despite splotches and breaks and disfiguration of all kinds, due to faulty amplification at the receiving end.

"However, while the ear may pardon much in the way of distorted music, and even get to like it for that matter, the eye is far more critical. With the eye, a thing must be *right*. Therefore, better amplifiers will be required, and resistance coupling is certain to find extensive use for a nearer approach to uniform amplification over a wider range of frequencies than is necessary in sound reproduction. I understand that even the present admittedly crude television experiments call for frequencies varying from 18 to 25,000! This is far in excess of the 200 to 5000 cycle range which is average for radio rendition."

Good Soldering Prevents Corrosion

THE average experimenter's mistaken idea that solder is used to make both a mechanical and electrical joint is responsible for most of the troubles due to loose and faulty soldered connections, according to P. C. Ripley, of the Chicago Solder Company.

Mr. Ripley, a recognized authority on soldering, goes on to say that solder should be used primarily to protect a joint from corrosion. Its use in making a joint mechanically tight is a secondary function.

The practice of making "butt joints"—that is, of crossing one wire over another or butting the end of one wire up to



Wallace Battison, radio NU1-HE, who designed the transmitting and receiving equipment used on the Fokker airplane *Friendship*, on its successful transatlantic flight, at the controls of one of the receivers in his laboratory

another and soldering the intersection—is not conducive to permanency, because soldered joints of that type are mechanically weak and can be loosened by jarring or by the tension which often exists in making them, especially when solid bus bar wire is used.

Conductor connections should always be made mechanically secure and electrically conductive without solder, by twisting or wrapping one conductor around the other. Then solder should be applied as a protection against corrosion, as a means of bringing the greatest surface of one conductor in contact with the other to reduce resistance and as an additional mechanical re-enforcement.



Radio is now used on board the fire-boats of New York City, and by means of it, alarms may be sent with greater rapidity. Above is one of the boxes from which the alarms are sent, and below is the equipment installed on one of the boats



Transformer Inductance Determines Tone

THE ability of an audio transformer to pass the lower musical frequencies—the frequencies which give mellowness and timber to audio reproduction—depends entirely upon its inductance. It has become essential, therefore, according to Ray H. Manson,



The mark of Hyatt Protection

Serving industry so well for 37 years has privileged Hyatt to symbolize the protection Hyatt Roller Bearings afford to the products which employ them.

Wherever they are applied the presence of Hyatts oftentimes is known only through the economies they effect. So this symbol was designed to visibly identify the inbuilt quality of Hyattized construction.

The Mark of Hyatt Protection now appears on many different types and makes of equipment. Seeing this mark, the buyer is reassured.

Perhaps your product needs Hyatt protection. Perhaps it would experience a more ready acceptance if equipped with these better bearings.

Without obligation to you, Hyatt engineers are available for conference—any time, anywhere.

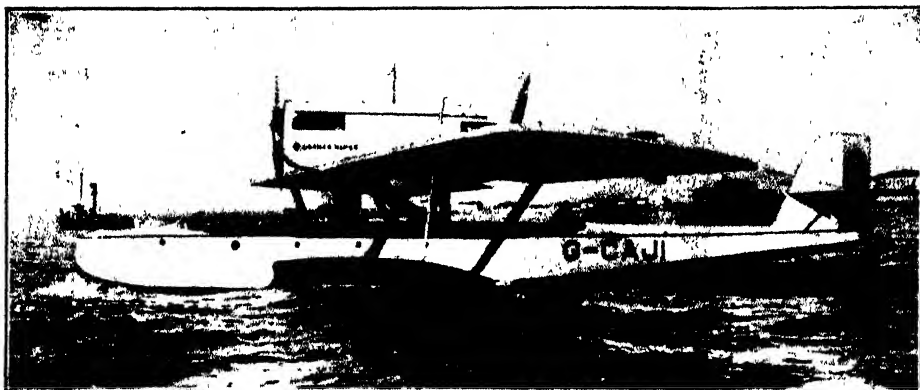
HYATT ROLLER BEARING COMPANY

Newark Detroit Pittsburgh Chicago Oakland

HYATT

ROLLER BEARINGS

PRODUCT OF GENERAL MOTORS



The Dornier-Napier seaplane of Captain Courtney, British pilot, on which is installed a short-wave radio transmitter employing the call letters G-CAJI

Chief Engineer of the Stromberg-Carlson Telephone Manufacturing Company, that transformers used in a receiver from which highest naturalness of reproduction is to be expected, must have very high inductance.

"In the manufacture of audio transformers," says Mr. Manson, "there has been a steady increase in the size of iron core used. The purpose of this increased size is to give greater inductance to the transformer.

"In the primary of an audio transformer there are both direct and alternating currents flowing—the direct current going from the 'B' supply to the plate, and the alternating audio current flowing from the plate and filament circuits through the primary to the secondary.

"The presence of high direct current tends to electrically saturate the core of the transformer and pull down its magnetic flux. Alternating current inductance, however, depends to a large degree upon the intensity of this magnetic flux. Thus it is seen that the high direct current, by electrically saturating the iron core, cuts down the alternating current inductance of the transformer.

"It is for these reasons that exceptionally large amounts of iron are now used, in order that the value of the core be so large that even with the high plate voltages used in modern radio receivers, the direct current saturation point of the core cannot be reached."

"B"-Eliminator Hints

THERE is nothing complicated about building a "B"-power unit. Given good components and a reliable rectifier, it is simply a question of proper mounting and wiring, together with these few hints,

Remember that you have a transformer at one end and choke coils at the other. Both have alternating-current flux. Therefore, guard against interacting fields which may cause excessive hum. Provide sufficient separation of units.

Use rubber-covered wire rather than bus bar. There is high voltage in the "B"-power unit. It is well to insulate against it.

Ground all metal cases of transformers, chokes, and condensers. It is well to place an electromagnetic shield, such as sheet iron or roofing tin, over the entire "B"-power assembly to prevent stray energy.

When motor-boating is encountered, try a larger condenser for the "tank" or last filter condenser. Values as high as 12 microfarads will be found to stop many cases of motor-boating, as well as improve

tone quality, particularly for the sustained bass notes. Also try an audio choke in each plus "B" lead from the power unit to the audio amplifier, together with two-microfarad condenser between each, a plus "B" lead and minus "B." In the radio-frequency end, try radio-frequency chokes in the plus "B" lead, with a .1 microfarad condenser shunted across the plus radio-frequency plate lead and the minus "B."

Avoid overloading the gaseous rectifier, either through excessive transformer voltage or excessive drain. Overload can be handled by the present-day Raytheon tubes for a short period, but it does no good. Tube life is materially shortened through overload.

New Aircraft Receiver

A NEW radio receiving set for use in aircraft has been designed by Dr. A. Hoyt Taylor and Edwin L. White at the naval research laboratories. Claims that are made for this set are ruggedness, selectivity and elimination of microphonic effects due to vibration.

According to the reports so far received, this set employs a quartz crystal for controlling the received frequency. Also, the

variable condensers of the standard well-known type have been eliminated and tuning is accomplished by means of a metallic plate called a tuning disk. The explanation of this last part as given by Dr. Taylor is as follows:

"The metallic disk has such a thickness that the natural period of the metal is outside the range of audibility; that is, its natural period may be above or below the range of audibility but mechanical vibration of the disk is such that no mechanical noises are introduced in the receiving circuit under conditions of vibration."

The set is designed for use for radio telephony and continuous or interrupted continuous telegraphy reception.

Radio in 35 Percent of U. S. Homes

ACCORDING to figures given by Thomas F. Logan when addressing the International Advertising Association in Detroit, Michigan, radio receiving sets are now to be found in 35 percent of the homes in the United States. These sets serve a total audience of 40,000,000.

In discussing the advertising phase of radio, Mr. Logan asserted that first-night audiences of popular musical programs by national advertisers run from ten to fifteen million listeners.

Radio Clergy

BECAUSE of the numbers that radio reaches, and their diversified faiths and beliefs, there is little doubt but that the very near future will find a special "clergy of the air" broadcasting by radio.

This is the belief of Merlin H. Aylesworth, President of the National Broadcasting Company. Some idea of what this clergy of the air will be like will be gleaned from a series of national programs entitled "Great Messages of Religion." In the transmitting of these series, clergymen of the Protestant, Jewish and Roman Catholic faiths will be invited to participate.



S. B. Whittier

The Air Corps of the United States War Department has equipped a complete flying radio laboratory with two transmitters, five receivers, and a quantity of testing apparatus. Above is a view of the laboratory in the Fokker plane

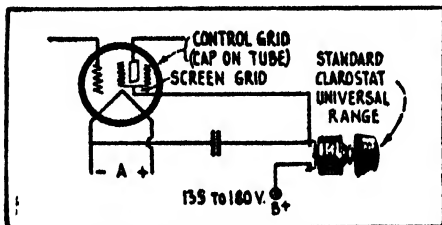
In speaking upon the subject of the "clergy of the air," Mr. Aylesworth said in part: "His creed is of no import: but his views shall be of the broad views of tolerance, and he shall represent the best of religious thought which the experience of 20 centuries has to offer."

Fifteen-Meter Waves

A WAVE of about 15 meters can be received with greater strength and regularity during day-time at distances about or over 5000 miles than at distances of the order of a few hundred miles.

Controlling the Screen Grid Tube

MANY sets and circuits utilizing the new screen-grid tube have been described in various publications. Nevertheless, little or nothing has been said regarding the need for close control of the operating voltages. The manufacturers of shielded grid tubes state that the screen grid should have a 45-volt positive bias, yet in actual practice it has been found that this voltage is quite critical and that it varies considerably with changes in other circuit factors. Under certain conditions, about 20 volts is most satisfactory, while with certain other conditions, up to within



Screen grid tube control

10 volts of the plate voltage provides the most sensitive operation.

It therefore becomes apparent that if this super-sensitive radio tube is to be employed at maximum efficiency, which is usually the intention when using it in place of the standard three-element tube, a high-voltage source, together with a micrometric resistance means of control, is required. The arrangement shown in the accompanying diagram is offered as a suggestion. It will be noted that the 135 or 180 volt source is reduced to the proper applied voltage by means of a standard clarostat, or micrometric variable resistance of enormous range, with a by-pass condenser of at least one microfarad connected across the screen-grid terminal and the negative filament terminal of the tube, so as to prevent feed-back and oscillation. The variable resistance is adjusted until the greatest amplification, together with crystal-clear quality, is obtained.

The plate voltage and grid bias for the screen-grid tube are not critical. The recommended values are 135 volts for the plate and one and one half volts for the grid bias.

European Radio Phone to Canada

RADIO telephone service from England to Canada has been extended so that subscribers in Belgium, Germany, Holland, Sweden, and France may also be served.

Ordinary cables connect these countries to the English transmitter at Rugby, and telephone connections are made in the usual manner. From Rugby the voice currents go via radio to Canada.



This unusual arrangement of wire ropes, sheaves and blocks was used in lowering two 55-ton rotors into the power plant of the Exchequer Dam, in California.

Big Dams!

Mammoth masses of concrete are being built throughout this country to impound millions of gallons of water for the development of power. Such "jobs" employ great quantities of highest grade wire rope, both for handling the structural material and the huge hydraulic machines.

Yellow Strand Wire Rope is always in evidence where loads are heavy—where super-strength is imperative and economy is desirable.

Imported steel wire, specially drawn, and the skill that can result only from vast experience, are responsible for the qualities which make Yellow Strand so popular among contractors of all kinds. The "strand of yellow" identifies the brand and protects the purchaser.

Broderick & Bascom, manufacturers of Yellow Strand, as well as all standard grades, have made wire rope exclusively for over fifty years.

BRODERICK & BASCOM ROPE CO.

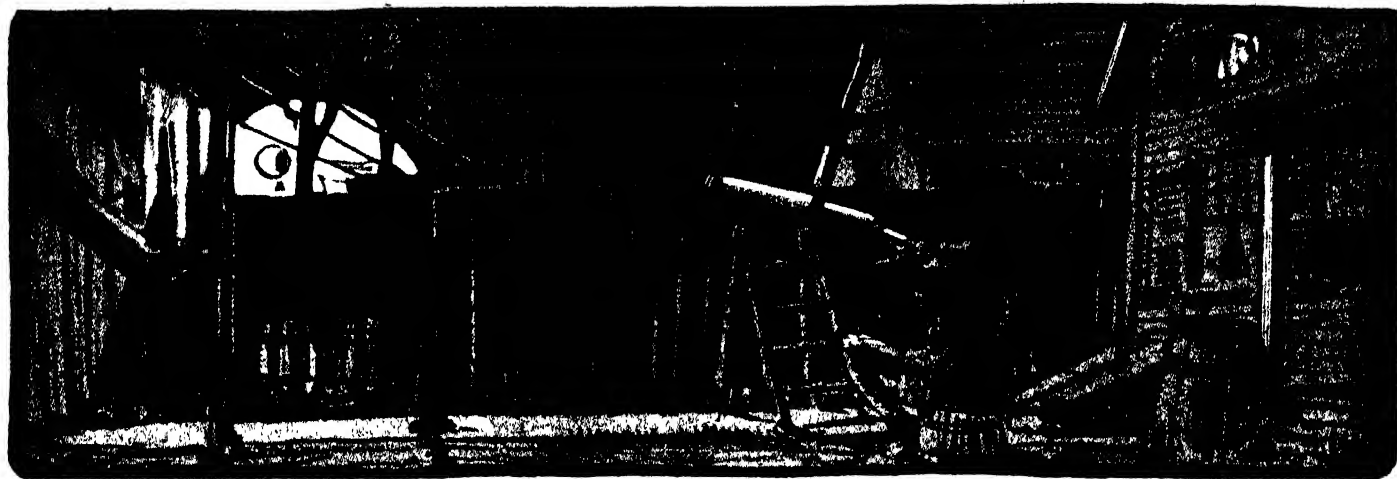
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The Back Yard Astronomer

A Department Devoted to Interests of the Amateur Telescope Maker

IT is a truly fascinating hobby that will bring together 50 or more of its addicts every year, when these people are forced to traverse several states in order to be present. Every summer the "Amateur Telescope Makers of Springfield," Vermont hold—as most of the habitual readers of this department now know—a sort of informal "get-together" of amateurs, the two-day affair always taking place at "Stellafane," the combined clubhouse-observatory of this interesting group of enthusiasts, situated on top of a fir-clad mountain near that community. The Telescope Editor has just returned from the third of these gatherings and he wishes at this time to urge all amateur telescope makers to lay long-range plans to attend the next meeting, which will be held nearly a year hence.

You go to these "get-togethers" in order to get together. Therefore the time available is not wasted in any foolish formalities but is almost wholly devoted to that which you doubtless wish to do, namely, to meet others who are interested in the hobby in which you are interested, to swap experiences having to do with it, to pick up new ideas and disseminate some of your own if you have any, and in general to keep track of what is going on in the world of telescope making, both amateur and professional.

At this year's meeting, one or two new telescopes were in evidence. These had been brought from afar, the majority of amateurs present having motored to the spot. One amateur, a woman by the way, brought along her mirror and by camping with her family in a tent pitched nearby in a grove, and thus prolonging the stay, she was able to perform the work under the supervision of others of greater experience. Porter, the leader, takes a great deal of interest in the efforts several of the ladies have made, possibly because it has been carelessly said that no woman could hope to make a telescope. None has, thus far, since the present telescope making campaign was begun by the SCIENTIFIC AMERICAN, but we have hopes. However, the conventions will hardly be likely to degenerate into a hen-party, and a man can still attend one of these gatherings in his

second or third best suit, if his wife will let him.

There was the usual supper whose "piece of resistance" as someone unfeelingly termed it, was beans baked in the old bean hole. This is simply a hole dug in the earth and heated by means of a prolonged



Russell W. Porter

fire, the pot of beans being inserted afterward and cooked all night. One of the "Stellafane" group, Mr. Redfield, happens to be a bang-up good cook and, *mirabile dictu*, he actually likes to cook. He is therefore the hub around which the Springfield amateurs revolve at mealtime.

Fifty-six may not seem to some like a very impressive muster for a convention, yet when you consider that the total num-

ber to draw from, that is, the total number who have obtained copies of the SCIENTIFIC AMERICAN book "Amateur Telescope Making," is something like 3000, and that fully half of these live west of the Mississippi or in foreign lands, and further that most of the others had to cover several hundred miles in order to reach the spot in Vermont, the attendance of this number of enthusiasts may be taken to indicate that the hobby is one which takes strong hold of the amateur.

Astronomy is becoming the leading science as far as popular interest is concerned, doubtless because it opens up vistas of grandeur and magnitude which appeal to people of all classes sufficiently intelligent to wonder what (and why) this Universe is. It was recently found by actual analysis that newspaper editors throughout the nation now give more space to astronomy than to any other science; and newspaper editors know what the average person wants.

At the gathering there were no set speeches or formal deliberations, but one could see all day, all night long and during all the next day, the usual knots of enthusiastic amateurs gathered around this or that visitor, soaking up some wrinkle or other; whether an account of the new telescope Professor Ritchey is planning, or a simple demonstration of the use of monochromatic light in figuring a flat, as explained by Porter, or the discussion of the newly available curves of the Schwarzschild telescope as elucidated by Director B. W. St. Clair of the Standardizing Laboratory of the General Electric Company, Lynn Works. There has been a great deal of mystery concerning these curves by means of which, coupled with other refinements of already existing methods, Professor Ritchey expects to obtain much greater results out of telescopes of the sizes at present in use, and even correspondingly more out of the larger instruments which he has planned. We hope to publish the details of these plans in some future issue.

But by all means the most epochal scientific work of the whole convention was the drainage of a small pond in the woods near "Stellafane." It happened this way: One of the less argumentative amateurs (Please turn to page 278)

The Scientific American Digest (Continued from page 257)

heavy rubber pads inserted between the truck and the body; truck noises are broken up by sound deadening material in the car floor; and the air pumps are insulated by the same material.

This company has also developed a new type of rail crossing in which the rails are sealed in a bed of asphalt. Due to the



Wide World

Street car noises were further lessened by inserting sound-deadening material beneath the floors. The results have been very satisfactory

resilience of asphalt, the noise due to the pounding of the wheels across the rail grooves is almost entirely absorbed.

The noiseless cars were designed and are being built by the Byllesby Company under whose management the railway is operated.

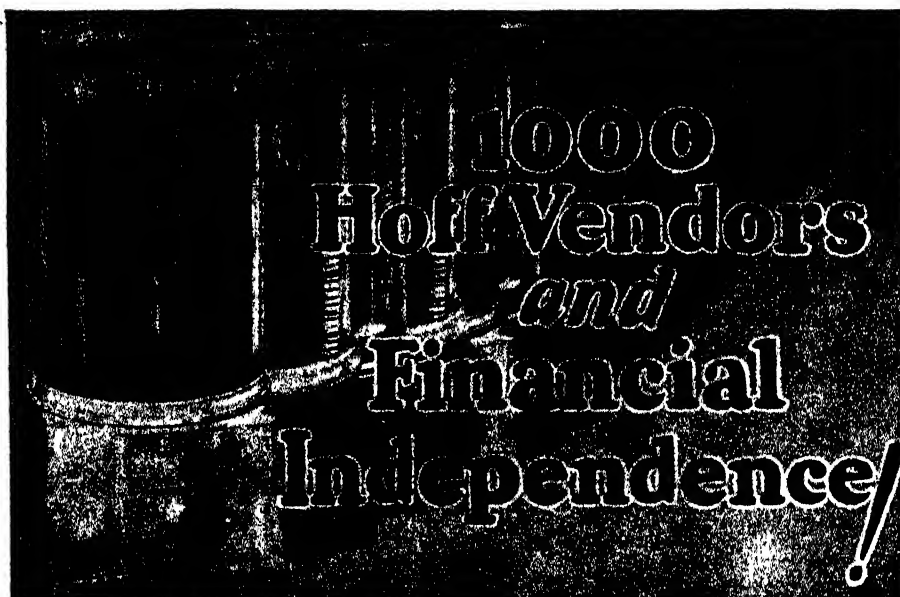
Fishes are Marked by Tattooing

TATTOOING spots under the scales of fish instead of fastening tags on them, is a new method of keeping track of aquarium specimens described by Ancel B. Keys of the Scripps Institution of Oceanography in a recent issue of *Science*. Mr. Keys marks fish too small for the ordinary tagging method by barely puncturing the outer skin with a hypodermic needle loaded with India ink. He reports that his scaly pets suffer no ill effects from the spotting operation, and that the marks last for several weeks.—*Science Service*.

Color Enters the Coal Pile

THE recent outbreak of vivid coloring in pots, pans, refrigerators, gas stoves and other domestic paraphernalia, ushered in by the advertising slogan, "Color Enters the Kitchen," seems to have induced emulation on the part of the cellar. At least, the familiar black diamond of the house-heating furnace is now blossoming forth in bright cerulean hues.

This new departure is due to the enterprise of the Glen Alden Coal Company, which has devised a means for dyeing its high grades of Lackawanna anthracite a bright blue. For some time there has been a movement on foot for the labeling of coal so that the consumer can be sure that he is getting the desired fuel. So far this move-



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FEW of those not in the vending machine business have any conception of the importance that the humble penny assumes when judged by the yearly volume of sales made by penny vending machines. In a single year it amounts to the striking total of over 600 million pennies. Right now there is an opportunity for a limited number of financially responsible individuals to enter the vending machine field, and to make a large profit from the operation of a comparatively small number of vending machines.

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Where the Bell System's profit goes

*An Advertisement of the
American Telephone and Telegraph Company*

THERE is in effect but one profit paid by the Bell Telephone System. This profit is not large, for it is the policy of the Bell System to furnish a constantly improving telephone service at the least cost to the public.

The treasury of the American Telephone and Telegraph Company receives dividends from the stock of the operating companies. It receives a payment from the operating companies for research, engineering and staff work. It receives dividends from the Western Electric Company—makers of supplies for the Bell System—and income from long distance operations.



Only one profit is taken from this money in the American Telephone and Telegraph Company's treasury. That is the regular dividend to its stockholders—now more than 420,000 in number—which it has never missed paying since its incorporation in 1885.

Money beyond regular dividend requirements and a surplus for financial stability is used to give more and better telephone service to the public. This is fundamental in the policy of the company.

The Bell System accepts its responsibility to provide a nation-wide telephone service as a public trust.

ment has not progressed to the point where it influences the power plant to any great extent. But it may be that we are entering an era when rainbow-tinted or otherwise trademarked coals will indicate for the purchaser the quality of the fuels he buys.—*Power.*

Three Female Deer With Antlers Found

THREE authentic specimens of female deer, equipped with antlers which are usually the exclusive property of the bucks, are reported to the *Journal of Mammalogy* by Joseph Dixon of the University of California. They were all secured in the same general region, in the neighborhood of Truckee, California. The horns were so developed that all three animals were shot under the impression that they were bucks. The antlers of one of the specimens were imperfectly grown and still "in the velvet" in autumn, but the other two had shed their velvet and were normal buck antlers to all appearance. All three of the animals belonged to the species known as the Rocky Mountain blacktail, or mule deer, and were larger than ordinary does.—*Science Service.*

New Two-Filament Miner's Lamp

A NEW two-filament incandescent lamp for miners, assuring adequate illumination throughout the day, has been developed by engineers of the General Electric Company at the National Lamp Works in Cleveland, Ohio.

The lamp, fitting into a small reflector



The new two-filament miner's lamp described in these columns

fastened to the miner's cap, is operated from a compact two-cell storage battery strapped to a belt about the miner's waist.

The two filaments operate at different intensities. The major filament, giving 14-beam candlepower of light, is used until it fails. Then a simple switch, attached to the side of the lamp, is turned, which throws the current into the low candlepower emergency filament.

This furnishes sufficient illumination for the worker to finish his day's work when a new lamp can be installed at the time the equipment is turned in for recharging the battery. The emergency filament is rated at low candlepower, assuring longer life than if the second filament were of the same candlepower as the first, which dis-

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charges the battery in about 12 hours. It is possible to operate the emergency filament for 30 hours or more, should an accident keep the miners underground for an extended period.

"In the past, lamp failures have often occurred when they are being used underground by the miners," C. E. Egeler, engineer of National Lamp Works explained. "It is not a practice at mines to provide a place below the ground for replacing burned-out lamps. Either the miner must be



A miner equipped with the new lamp and accessories. If one filament fails, another is turned on

furnished with another equipment, or he must go to the lamp house on the surface to obtain a new lamp.

"Usually in the past, he stopped work for the day with a loss both to himself and to the mine operator. The introduction in 1919 of a cap lamp equipment having two lamps was a natural development. Only one lamp could be burned at a time, and the other could be turned on should the first fail. Now this condition has been corrected by the two-filament lamps."

Cornell University Gets Wild Life Preserve

CORNELL UNIVERSITY students will be able to carry on field studies in botany and zoology in wild life preserves owned by their alma mater, as the result of gifts of tracts of wild, primeval country presented by the late C. G. Lloyd of Cincinnati. His most recent donation, made just before his death, consists of 110 acres containing three interesting glacial "pot-holes." Two earlier gifts were of 80 and 400 acres, respectively—*Science Service*.

Fish Stories to Aid Science

FISHERMEN who yearn for an audience to listen to the size and weight of their catch are having an ideal time in Wisconsin this summer. A complete survey of game fish in the state is being made by the Wisconsin Geological and Natural History Survey in co-operation with the United States Bureau of Fisheries, and all sportsmen in the region have been called upon to help with the evidence.

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Learning to Use Our Wings

(Continued from page 260)

then ignited, dissipating its energy.

With gunpowder, the process of creating enormous energy can be instantaneous or practically so. Therefore, while a jet-reaction engine, in which gasoline would be burnt in a special chamber, and the exhaust gases pass out through a jet, would be a more efficient reaction mechanism, it would not be one capable of developing enormous energy in a short space of time.

The jet-reaction engine becomes efficient only when the velocity of the outflowing gases is not much greater than the velocity of the air streaming past the moving vehicle which contains the jet-reaction engine.

Therefore when we want to build airplanes flying at 1000 miles an hour or thereabouts, we shall be quite justified in turning to the gas-reaction engine.

The weight of a gas-reaction engine will be appreciable, although not so great as that of an ordinary combustion engine. Its present-day inefficiency may be overcome by special air injectors, or other methods of entraining a large quantity of air with the issuing gases.

But to fly an airplane at 1000 miles an hour will need vast power, much greater than we can get from even a jet-reaction engine of the most developed type.

Suppose we want to anticipate the development of time and attain terrific speeds with an automobile or an airplane today. Is the rocket useful for such a purpose?

It is if we want to get these tremendous speeds for very short periods. We can then disregard economy and by using gunpowder and the rocket, concentrate enormous horsepower capacity in a very small mechanism.

For inter-stellar navigation we need to drive our vehicle for a comparatively short time to get it out of the earth's gravitational influence, and hence again the light, comparatively short-lived rocket is our obvious method of attack.

The Germans first concentrated their efforts on the rocket automobile. The German manufacturer von Opel backed the engineer Max Valier in his device for propelling motor cars by rockets. A translation of the *Hamburger Nachrichten* reads as follows:

"The unusual machine stood on the race track, a low, lightly constructed racing car without a motor. The rear end is a steel box or case, with 12 round openings from which project the blast pipes of Congreve rockets, each having a diameter of nine centimeters. The ignition wires run from the blast pipes to an automatic switch operated by the pilot by means of a foot pedal. Supporting stays are attached invertedly to the car behind the front wheels and have for their purpose the pressing of the car to the track during the run."

The first test made by Volhart, an experienced racing car driver, made an immense impression. The car attained a speed of 60 miles per hour in eight seconds, which is an enormous acceleration, equal to that of the powerful airplane catapult.

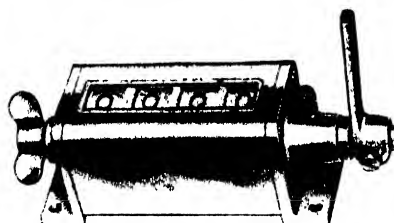
From this description it is evident that no wonderful new principles of rocket design have been discovered. Perhaps each rocket was loaded with successive charges or, what is more likely, the rocket was a comparatively slow burning one. In either case nothing wonderful in the purely technical sense is presented.

Now let us turn to the description of the

Veeder-ROOT

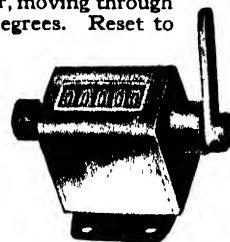
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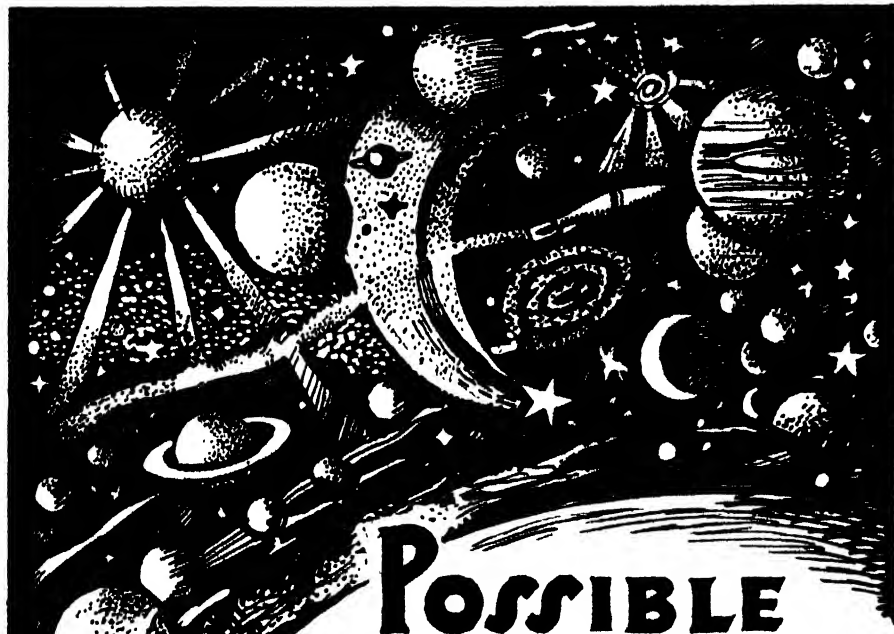
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first airplane flight with rocket, made with the glider *Ente* of the Rhine-Rositter Experimental Society by Fritz Stamer.

After two failures with smaller rockets, the *Ente* was equipped with two rockets of 20 kilograms (about 44 pounds) thrust. With the aid of the rocket and a rubber catapulting mechanism, Stamer left the ground successfully, flew 230 yards in a straight line, made a turn of about 45 degrees, flew another 800 yards, made another curve of 45 degrees, then lit the second rocket and made another curve and straight flight. Altogether he flew about 1500 yards, in some 80 seconds. The thrust of the burning rocket was apparently quite regular, though weak at the beginning. The burning of the rocket was accompanied by violent sizzling. His experiments ended by the explosion of a rocket, due to preliminary shaking up of the rocket in transit, and the burning of his plane.

As a result of these flights, certain technical lessons emerge, such as measures for fire prevention, placing of rocket in a certain position or balancing it so that the position of the center of gravity does not change when the charge is burned, et cetera.

Each rocket burned four kilograms of powder, which is an indication of the enormous expenditure of propulsive material needed for short flights.

On the whole we are inclined to think that the rocket as applied to the airplane might be a means of securing stupendous speeds for a short interval of time, rather than a method of very speedy sustained flight.

The Curtiss Chieftain Engine

ARTHUR NUTT, writing in *Aviation*, gives an illuminating study of the novel and interesting Curtiss Chieftain, a 12-cylinder, hexagon engine, with cylinders arranged in two rows.

The engine develops 600 horsepower, and is the largest air-cooled engine in this country. Installed in a Falcon observa-



A three-quarter end view of the Chieftain engine, showing how the cylinders are arranged in six sets of two each around the crankcase. Note the large cooling areas

tion plane it enabled the plane to give a higher performance than any other two-seater plane in the service.

The great problem in the design of the air-cooled engine is to keep down head resistance so as to maintain performance, and to keep the diameter within reason so as not to impede the pilot's vision.

In the Chieftain, these objectives were

attained by having two rows of six cylinders behind one another, instead of having one row of radial cylinders in the same plane.

With the two rows of six, adequate cooling is secured, because the spacing between the engines is comparatively large. When two rows of seven were tried the cooling was found to be insufficient.

Another advantage of the two-row engine



Side view of the Chieftain, showing manifold ports on the upper cylinders, where the manifold has been removed. Head resistance of this engine is low, increasing efficiency

in large powers is that there is far less blanketing of the propeller. The frontal area of the hexagon is approximately one half of a nine-cylinder radial engine of the same power.

The main characteristics of the Chieftain are: 600 horsepower at 2200 revolutions per minute; diameter of engine, 45 inches; bore $5\frac{1}{8}$ inches; stroke, $5\frac{1}{2}$ inches; fuel consumption, .53 pounds per horsepower hour; oil consumption, .020 pounds per horsepower hour; total weight 900 pounds or only one and a half pounds per horsepower.

Picking Up Parcels

THE problem of communication between the ground and aircraft is of importance in military maneuvers. Panels, radio, flares, and Very pistols have been used with varying success. Cavalry troops in the Philippine Islands have evolved a "pick up" system which eliminates tedious alphabetical signal transmission, and avoids all errors, since the airplane observer receives the actual map or written message. The apparatus used is very simple and light. A small lead weight is suspended by string, wound on a reel on the side of the observer's cockpit. The line for the message is also a string formed into a large loop. The message is placed in a first-aid pouch, hung to the bottom of the loop, while the upper half of the loop is stretched overhead at arm's length, and held between the fingers of two men, standing about 40 feet apart. The observer unreels 40 or 50 feet of the weighted line, and as the plane flies at right angles across the center of the loop, the weighted line from the plane picks up the loop and its attached message.

A similar "pick up" principle has been successfully employed by Blaine M. Tuxharn, a Kansas City aviator, only he employs a hook attached to the landing gear of the plane. When the hook meets the ground wire, electrical contact is made and a cannon fired. The cannon shoots the parcel forward so that all accelerating jar on the plane is avoided.

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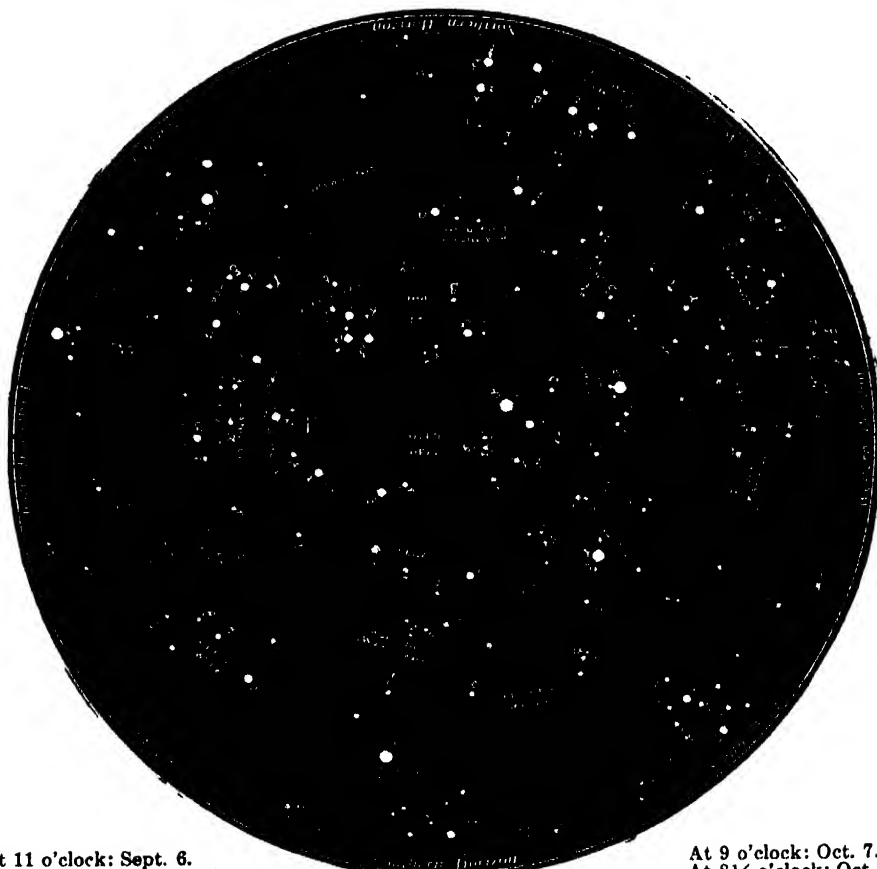
(Continued from page 270)

attempted to sleep instead of staying awake all night to settle points in telescope making. A single mosquito, doubtless the incarnation of some evil spirit, prevented said sleep from taking place. This amateur, no sooner had day broken, secured a shovel

and by herculean efforts dug a ditch that drained the pond which doubtless represented the old homestead of the mosquito. So, next year when you come to the get-together, you will find the bottom of the pond dusty and the last mosquito vanished from Vermont. Now will you come?—*A. G. I., Tel. Ed.*

The Heavens in September

BY PROF. HENRY NORRIS RUSSELL, Ph. D.



At 11 o'clock: Sept. 6.

At 10½ o'clock: Sept. 14.

At 10 o'clock: Sept. 21.

At 9½ o'clock: Sept. 30.

At 9 o'clock: Oct. 7.

At 8½ o'clock: Oct. 15.

At 8 o'clock: Oct. 22.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on September 6, etc.

NIGHT SKY: SEPTEMBER AND OCTOBER

MERCURY is now an evening star. During the latter part of the month he is well clear of the Sun, reaching the greatest elongation, 26 degrees, on the 30th. However, since he is 12 degrees farther south than the Sun, he is at a disadvantage for northern observers, setting not long after 6:30 P.M., so that he can be seen only in the twilight.

Venus is an evening star too, and is in conjunction with Mercury on the 10th and again on the 30th. On the former date the two are too near the Sun to be seen easily, but on the latter Venus should be conspicuous and should help to find Mercury which is three and one half degrees to the southward. Between these dates Mercury is near Venus and may be picked up to the left of the brighter planet and a little below her.

Mars is in quadrature with the Sun on the 14th and is then due south at 5:48 A.M. He is in Gemini at about 10:30 P.M. and his increase in brightness as he draws nearer the Earth is conspicuous. Although he is still about a hundred million miles away, astronomers will be hard at work measuring the planet's heat, photographing the surface, and observing it visually.

Jupiter is in Aries, rising between 8

and 9 P.M., through the whole of the year.

Saturn is in quadrature east of the Sun on the 5th and can be seen till late in the evening.

Uranus is in opposition on the 28th—in R. A. 0^h 20^m; declination +1° 28', when he may be found with the aid of a good star map. He is just visible to the naked eye, but a field glass will be a great help in finding him, even if it is one of very poor power.

Neptune is a morning star just past conjunction and hardly observable.

The Moon is in her last quarter at 5:35 P.M. on the 6th; new at 8:21 P.M. on the 13th; in her first quarter at 9:58 P.M. on the 21st; and full at 7:43 A.M. on the 29th. She is nearest the Earth on the 4th, and farthest away on the 20th. Upon her round of the zodiac she overtakes Uranus on the 2nd, Jupiter on the 4th, Mars on the 7th, Neptune on the 12th, Venus and Mercury on the 15th, Saturn on the 20th, and Uranus again on the 29th.

At 2 A.M. on the 23rd the Sun crosses the celestial equator and passes through the point of the heavens which is called the autumnal equinox; at which moment, according to the almanacs, "autumn commences."

Industries From Atoms

(Continued from page 264)

authorities in this important branch of rubber manufacture, pointed out at a recent meeting of the American Chemical Society that the day has just arrived when the research chemists have joined forces in a campaign to attempt really to regenerate vulcanized rubber.

"Present-day processes," says Mr. Shoaff, "never re-impart the two properties of solidity and elasticity exhibited by raw rubber. Vulcanized rubber, especially after long use has undergone such complex physico-chemical changes that we may never restore it to its original state, though it is certainly not beyond the realm of possibilities in this day of seeming miracles.

"Just as vulcanizing is more than the result of the combination of rubber and sulfur, so the removal of the combined sulfur may not be expected to re-impart automatically the properties of the original rubber. When Spence removed a large portion of the combined sulfur from vulcanized rubber with aniline-sodium he obtained a plastic material; probably due to the softening effect of the aniline. Dubose did not obtain a plastic product when he effected the removal of over 50 percent of the combined sulfur from vulcanized rubber by boiling it in a solution of hexamethylenetetramine. It seems that in the devulcanizing process we have to deal more with depolymerization or disaggregation; and if the removal of combined sulfur should coincidentally restore vulcanized rubber to something like its original condition, we must look farther than a method such as the alkali process or any of the proposed schemes described in the hundreds of patents on the subject.

"Solvent processes cause depolymerization to a high degree, as is shown by the changes in viscosity. The solvent dissolves the depolymerized materials and the product tends to be too soft and tacky for ordinary use. Some modification of Bary's osmotic process in which he employed xylene may be the answer. Catalysis will no doubt play a principal role in true regeneration. The problem merits the attention of the research chemist in co-ordination with his efforts to learn the mechanism of vulcanization, if for no other reason than that the solution of either may lead to the discovery of the other."

Thus an industry built upon the still mysterious phenomenon of vulcanization seeks the secret of reversing that process, a secret upon which may be built, eventually, new industries of comparable magnitude.

Black as Your Hat—Tons of It!

GRAMMARIANS tell us that adjectives of color can not be compared. In other words, a thing may be "black" but can not be "blacker." Any one who has ever cleaned out a kerosene stove will agree that as far as carbon black goes, nothing could be blacker. The carbon black produced for commercial purposes is made by burning natural gas under conditions which cause the deposit of the maximum amount of the "soot." One of the main uses for the product is in the rubber industry, where it is an important compounding ingredient.

An idea of the magnitude of the carbon black industry in this country is revealed by statistics just issued for the state of

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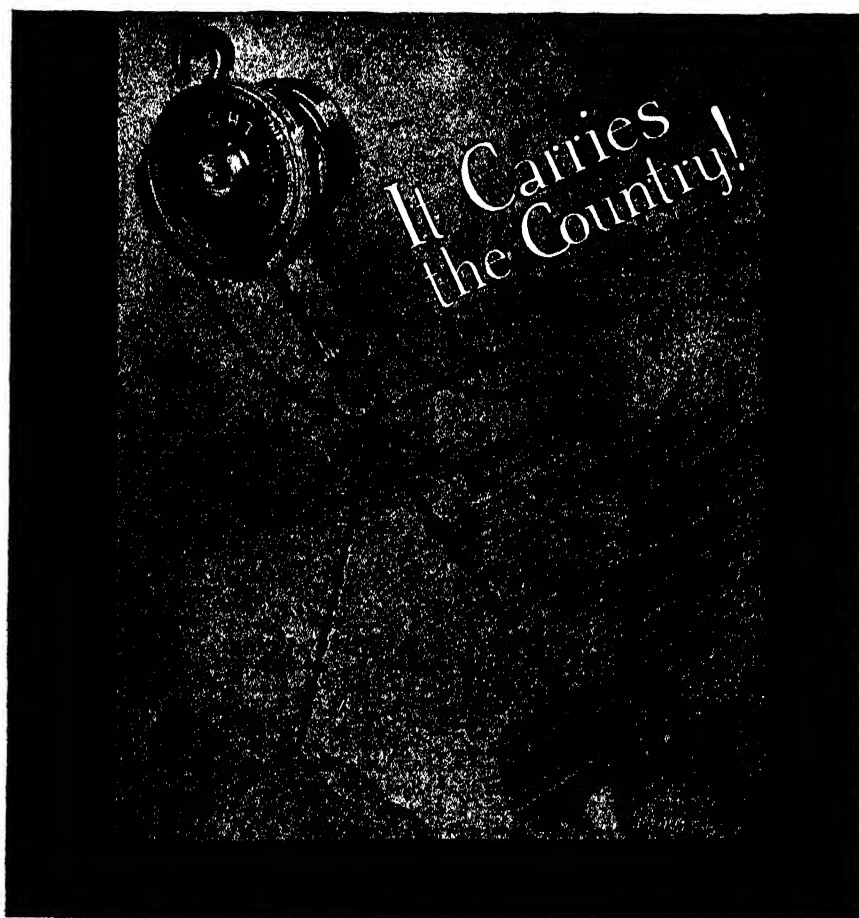
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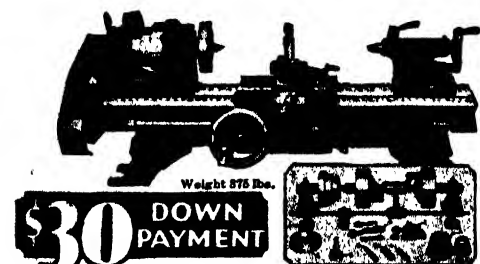
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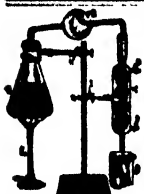
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Texas. Although the law allows only the residue from natural gas after it has passed through casinghead gasoline plants to be burned for making carbon black, the production of the latter in Texas this year is expected to exceed 75,000,000 pounds. In 1927 the output of carbon black in Texas was 20,174,409 pounds. It is stated that before the end of the year more than a dozen plants will be in operation, most of them in the Panhandle district.

Steel Photographs Produced With Aid of High Explosive

SHOOTING a photograph into the hardest of chrome steel with the aid of high explosive nitro-starch, and so making a photographic record as permanent as the steel itself, is the feat that has been accomplished as a result of the "Munroe effect." This effect was the discovery of Dr. Charles



Dr. Charles E. Munroe examining a photograph of himself reproduced in steel by the Munroe effect

E. Munroe, veteran explosives expert of the United States Bureau of Mines here.

A steel photograph was made recently by G. St. J. Perrott, superintendent of the Bureau of Mines experiment station at Pittsburgh, and sent by him to Dr. Munroe. To make it, a zinc etching, such as is used in reproducing illustrations in printed matter, was made from the photograph, and then this was used to make a paper mold. A mold of flour could also be used. The mold was then placed on a piece of steel about two inches in diameter and an inch thick. On top of this was placed a disc shaped piece of the nitro-starch explosive, which was then fired. Though the mold was destroyed, when the steel cooled sufficiently to be handled, the profile of Dr. Munroe was found impressed on its surface. Where the photograph had been black, that is, in the shadows, the surface of the steel was raised, and where there had been high lights, the steel was incised.

Another example of the effect that is in Dr. Munroe's possession now was made by W. O. Snelling, director of research of the Trojan Powder Company. In this case the words "Munroe Effect" were impressed into the surface of a block of the explosive, so that the letters were in intaglio. When this was exploded on a disc of the steel the

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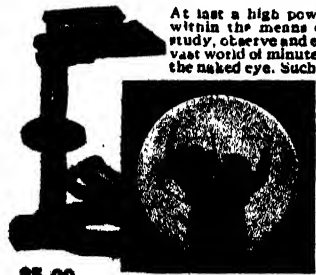
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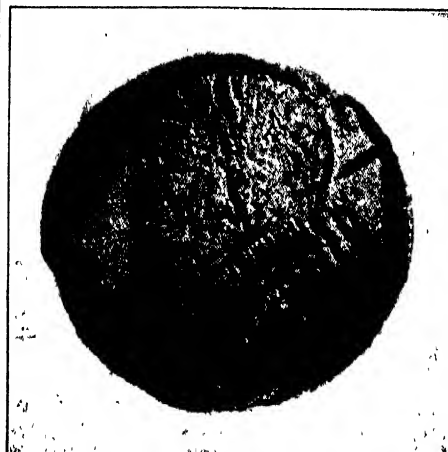
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letters appeared on it. However, they were also in intaglio on the steel. This is the opposite from what would be obtained with a die, for then the intaglio letters on the die would come out in relief on the finished product.

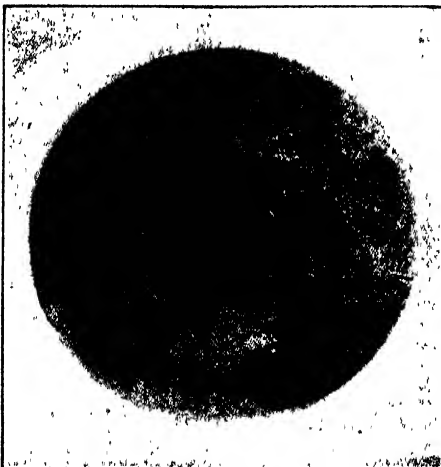
Dr. Munroe explains the effect by saying that when the detonation of the ex-



The photograph which was pressed in steel by the Munroe effect

plosive occurs, the entire amount of the solid is converted to gas. This volume of gas, however, momentarily has the same size and shape as the original block of the explosive, and is therefore extremely compressed. Where there was a cavity in the original explosive is the line of least resistance for the escape of the rapidly moving gas molecules. In seeking to escape, they collide with each other, producing a vast number of tiny molecular drills, which bore into the hardest steel.

Using the same principle, Dr. Munroe once blew a hole in a safe with a hollow cylinder of dynamite. He took a bundle of

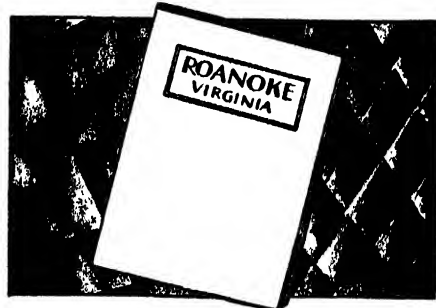


Another example of the Munroe effect. The words are stamped in

sticks of dynamite, then, by pushing a tin can through the center, he pushed out the center sticks, and bound together the other ones so as to form a ring. This he exploded in a vertical position upon a safe. The result was a hole in the top of the safe corresponding to the hollow center in the ring of dynamite sticks. This hollow cylinder had acted as a gun to fire the gas molecules through the steel.

Any thin object, such as a leaf, can be reproduced on steel in this way, said Dr. Munroe, and so a permanent record can be obtained.—*Science Service.*

A city of Amazing GROWTH



**Invites You to
write for this Survey**

WHAT better indicator of a city's industrial facilities than its growth? Here are the figures on Roanoke: In 1880, its population was 669; in four years it grew to 5,000. Six more years raised it to 16,000. Today, its community population is past the 80,000 mark!

"Amazing!—phenomenal!—magical!" Such are the exclamations of men who read the figures on the growth of this comparatively young Virginia city. But when they read the ROANOKE BRIEF—a survey of Roanoke's industrial facilities, the reason is clear why it has grown so rapidly.

Did you know that Roanoke is the location of the world's largest artificial silk (rayon) mill? The location of 113 different industries, with some plants here the largest of their kind in the South? A distributing center of big national manufacturers?

The ROANOKE BRIEF will tell you why anyone considering new plant locations, branch warehouses, etc. should investigate Roanoke. Write on your business letterhead for the ROANOKE BRIEF today. Experts in city layout are now mapping out plans for Roanoke's future industrial growth, which means that now is the most opportune time to plan your move to this progressive southern city. Address: Chamber of Commerce 217 Jefferson Street, Roanoke, Virginia.

ROANOKE VIRGINIA

A Vacation Paradise

SPEND your vacation in Roanoke. Whether you come in Summer, Fall, Winter or Spring, you will find a delightful climate, beautiful mountain scenery, and a thousand other things to make you glad you came. Come in your car. The roads in this section are fine and modern hotels are plentiful. Free upon request, authoritative tour booklet—"The Log of the Motorist through the Valley of Virginia and the Shenandoah."

CHAMBER OF COMMERCE
217 Jefferson Street, Roanoke, Virginia

Our Choice of Recent Books

Beyond The Electron

By Sir J. J. Thomson

THE author dissects the *electron* itself which he considers no longer to be the final stage in the structure of matter. This small book should interest all who are following developments in atomic physics, especially those who are on speaking terms with the latest atom concept of de Broglie and Schrödinger. . . \$1.00 Postpaid

The Story of Geology

By Allan L. Benson

AN unusual work. Geology has long been virtually a closed book to the average person, because there has been scarcely a book about it which one would care to open the second time—so dull were they—unless he was a specialist in that science. Too much stress, even in teaching, has always been laid on the confusing eras, periods and epochs of the professional—Benson's book omits this maze. It is bright, almost breezy, full of interest, authentic—nevertheless it outlines clearly the extant theories of earth science and tells what the average man wants to know about geology.

\$4.20 Postpaid

Elements of Astronomy

By Edward Arthur Fath

ALTHOUGH only two years have elapsed since the first publication of this work, which at once became widely known and as widely used because of its marked lucidness of exposition, the author has revised it, bringing it up to the latest possible moment. This shows how rapidly astronomy is advancing. To anyone who wishes to make a rapid survey of the new astronomy without becoming involved in mathematics and advanced physics we heartily recommend this work. . . . \$3.20 Postpaid

Astronomy and Cosmogony

By Sir J. H. Jeans

A NOTABLE new work by one of England's three most brilliant cosmological thinkers, just knighted for the very research outlined in this book. Cosmogony—the dramatic birth and career of satellites, planets, suns, galaxies and the whole Universe—is its all-inclusive scope. Those who habitually read Professor Russell's articles on astronomy should find it most valuable and interesting, although it is not a textbook of astronomy. No grander subject than cosmogony exists in the universe—for the universe itself is the subject of the study. . . . \$10.25 Postpaid

Modern Gasoline Automobile

By V. W. Page

A PRACTICAL comprehensive treatise explaining all principles pertaining to gasoline automobiles and their component parts, and showing every recent improvement. An authoritative and conclusive reference. . . . \$5.20 Postpaid

Patent Law for the Inventor and Executive

By H. A. Toulmin, Jr.

PATENT procedure, based upon facts and practical examples gleaned from long and successful practice, is outlined in all its details. The protection of the inventor's new ideas, the proper relation of the corporation to those who work in its research laboratories, ways of stimulating new inventions, these are all discussed in a practical and helpful fashion. . . . \$4.20 Postpaid

About Ourselves

By H. A. Overstreet

THIS is a psychology for normal people. It is written out of the conviction that we "normals" need to know a good deal more about ourselves than we ordinarily do. It reveals ourselves to ourselves. A sane application of psychological research to modern life. . . . \$3.20 Postpaid

Abraham Lincoln

By Albert J. Beveridge

THE author of "The Life of John Marshall" is conceded because of that work to rank among the great biographers. His subject of the present work offers an opportunity ever more happy, so that a reception may be expected that will materially exceed that of the former book. More facts of Lincoln's earlier life and times are presented than have ever before been assembled, and all are outlined with eloquence and dramatic force. Illustrated—2 vols. . . \$12.50 Postpaid

Dick Byrd

By Fitzhugh Green

ALTHOUGH written as a boy's book, this is the story that many grownups have been wanting to read. The early life and adventures modestly eliminated from "Skyward," but now told by a relative whose pen limits none of the ardent youthfulness and boyishness of the man who now receives the acclaim of the world. The first line is a good sub-title for the book. "This is the story of a boy who wanted to see the world." \$1.90 Postpaid

Blades

By George Barr McCutcheon

WELL known and beloved as the author of the Graustark series, all who like "a good story well told" will want to read this book just out. \$2.00 Postpaid

Fundamentals of Biology

By A. W. Haupt, Asst. Prof. Botany, University of California

THESE are the days when individuals are themselves learning of the sciences which function in their daily life. This survey emphasizes the fundamental principles common to all living things—teaching biology from the cultural viewpoint—and with clear and understandable presentation showing the place and application of biology in its particular relationship to ourselves.

\$3.20 Postpaid

For Sale by SCIENTIFIC AMERICAN

Elements of Astronomy

By Edward Arthur Fath

A new second edition of a valuable book. When the first edition appeared two years ago it immediately became widely popular as a book which made the subject clear and understandable. Knowledge of astronomy, however, is increasing constantly; new facts have been learned in the last two years. Wherefore, the author has revised his work to include the discoveries of importance. To any man who wishes a quick survey of the new astronomy, without becoming involved in mathematics and advanced physics, we recommend this book. It is the latest and most up-to-date astronomical work to be found.

\$3.20 postpaid

Building and Flying Model Aircraft

By Paul Edward Garber

The building and flying of model airplanes is not only a fascinating sport, as thousands of boys have found, but a practical preliminary training in aeronautical engineering and design as well. Every American boy is interested in aviation and there is no better way for him to learn than to make and fly small aircraft. This work, the official publication of the Playground and Recreation Association of America is a complete handbook for builders of model planes.

\$2.40 postpaid

Inventions and Patents

Their Development and Promotion

By Milton Wright

This is a book for the inventor; it tells him what to do and what not to do after his invention is perfected, if he hopes to make money from his idea. Chapters on finding a buyer, on royalties, on the field for inventions, on forms of contract, on placing a value on the patent, on pitfalls for patentees, are especially valuable. Every patent attorney should read it and pass it on to the inventors who are his clients. Appearing first only a year ago, it now is in its third printing.

\$2.65 postpaid

Scientific American Publishing Co.
24 West 40th Street, New York, N. Y.

Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Hooks and Eyes

WHO invented the hook and eye fastener?

Ask any number of men that question, and out of every ten who will answer, nine will say De Long. They will be mistaken. Who really was the original hook and eye inventor is hard to say, but the earliest patentee of whom we happen to have knowledge is Alvin Childs Mason, of Springfield, Vermont.

Mason's patent issued April 9, 1861. He describes it by saying:

"The object of the within described invention is to facilitate the unhooking or detaching of the hooks from the eyes when necessary, and also to prevent the bending and injuring of the snap or spring-guard, a contingency consequent on the difficulty and embarrassment frequently attending the unhooking of the hooks provided with the usual snap or spring-guard.

"The within described invention consists in having the end of the snap or spring-guard bent so as to extend obliquely into

bend of the hook, said hook and loop being intermediate of said side bars."

While the De Long hook and eye was a useful invention, it was a slogan that made it really famous. In a day when advertising and slogans were not so widespread as they are now, the whole world associated De Long and hooks and eyes with the famous catch-phrase "See that hump!"

The Crowded Art of Slot Machines

"I HAVE an idea for a new invention," someone writes to this department nearly every week. "It is to sell tooth brushes [or sandwiches or some other universally used article] through slot machines. I am willing to sell my right to obtain a patent for a substantial sum."

We have yet to receive such a letter suggesting something we have not already seen sold by vending machines. Following are only a few things you can obtain by dropping a coin in a slot:

- Newspapers and magazines
- Matches
- Peanuts
- Chewing gum
- Pop corn
- Postcards
- Target practice
- Stereopticon views
- Your weight
- Postage stamps
- Towels
- Perfume
- Napkins
- Collar buttons
- Cigars and cigarettes
- Saving bank receipts
- Pencils
- Candy
- Drinking cups
- Sandwiches
- Aprons
- Milk
- Tooth brushes and tooth paste
- Music
- Ice cream cones
- Combs
- Soap
- Stationery
- Handkerchiefs
- Bloomers

Such a partial list is suggestive of the fact that it is difficult to think of a new machine-vended article. And even if you could think of one, that is not invention. The invention must lie in the novelty of the machine you devise for the purpose. Here there is difficulty, for we have had vending machines for many years and the degree of patentable novelty remaining in the art does not seem to be great. Nevertheless, every once in a while an inventor does come out with a new idea in slot machines which rewards him handsomely.

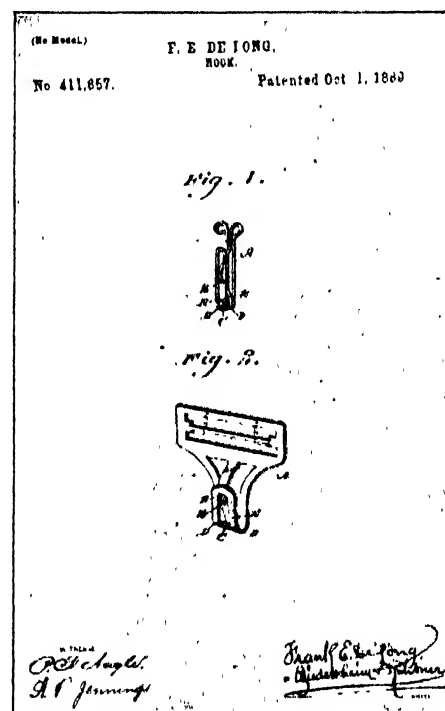
Delayed Claims

IF you have a right to use a patented invention, do not delay to assert that right. Your delay may have the effect of stop-

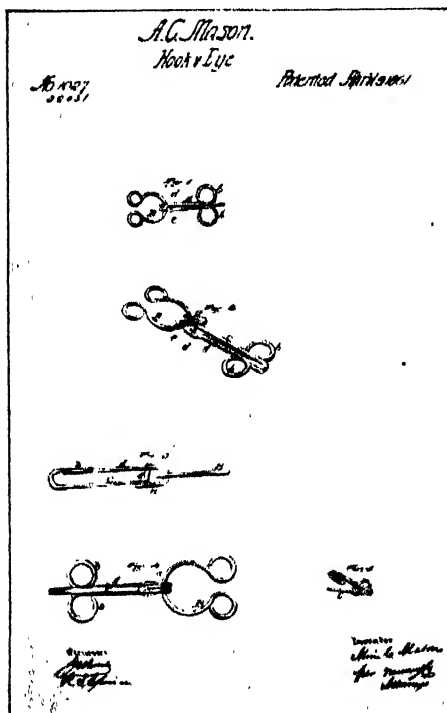
ping you from asserting it at a later date.

Such proved to be the case with regard to the recent controversy between The Texas Company and the Gulf Refining Company, over the patent obtained in 1922 by Almer M. McAfee for a process for converting, by the use of aluminum chloride, high boiling petroleum oils into low boiling products, including gasoline.

Soon after McAfee obtained his Doctor of Philosophy degree at Columbia University, he became employed in the laboratory of The Texas Company, his superior being G. W. Gray, a chemist. Pursuant to Gray's orders, McAfee developed his



This is the patent, used with the slogan, "See that hump," which made the hook and eye famous



The World War saw the rise of the hookless fastener; the Civil War saw the rise of the hook and eye

a loop or opening in the hook, substantially as hereinafter shown and described, whereby the desired end is attained."

But what of Frank E. DeLong? He was a late comer in the field, his patent issuing October 1, 1889. He describes his invention as follows:

"My invention consists of a hook or fastening for a garment, composed of front and rear portions or the hook proper and the shank formed of substantially parallel sides or bars, and a tongue having its free end forming a loop coincident with the

process for making gasoline. Gray, however, applied for a patent in his own name; the company paying the cost of the application. McAfee protested at his name not being included in the application, but the company refused to recognize his claim to either that invention or another one he had made.

McAfee resigned and entered the employ of the Gulf Refining Company. He applied for a patent and his new employer bore the expense. The Patent Office declared an interference with Gray's patent. After a four-year contest, McAfee finally was declared the rightful inventor and the patent issued to the Gulf Company, his assignee.

All this time The Texas Company was claiming that Gray was the inventor. Not until October, 1924, when it filed a suit in a Texas State Court, did it claim a shop right in the process on the ground that it was invented by McAfee while in the employ of the company. It was too late.

Judge Walker, spokesman for the Circuit Court of Appeals for the Fifth Circuit, writes as follows:

"Long before the litigation as to the patent began the appellant was aware that McAfee claimed to be the inventor of the patented process. From the beginning appellant had knowledge of the facts upon which it based the claim asserted in this suit. Notwithstanding its possession of that knowledge, for more than nine years it refrained from making the claim now asserted, in the meantime so conducting itself as to conceal from appellee even the probability or possibility of such a claim being made, though from the time appellant was first informed that McAfee claimed to be the inventor or discoverer of the process in question it was open to appellant to assert its equitable ownership of that invention or discovery and to compel the transfer to itself of the right thereto before the patent was issued.

"The circumstances of appellant's delay in disclosing the existence of the right now asserted were such that that delay had the effect of a concealment calculated to influence appellee to change its position in a way that was to its detriment if the decision it was seeking to bring about could result in no material benefit to appellee.

"For reasons above indicated, we are of opinion that appellant's delay, in the circumstances disclosed, in making such claim as the one it seeks to enforce in this suit, had the effect of stopping it to assert and enforce that claim against appellee."

For Humane Inventors

THE difficulty of finding just the right invention for a particular purpose is indicated by the following advertisement which appeared recently in the *Illustrated London News*:

£300 for a Trap

With the object of finding a humane rabbit trap which will be a substitute for the cruel steel-toothed trap, the R. S. P. C. A. in conjunction with the S. P. C. A. of Edinburgh, Glasgow and Aberdeen, offer a PRIZE OF 300 POUNDS for the best humane trap—one that will kill a rabbit instantly.

No entrance fee.

For further particulars apply to the Chief Secretary of The Royal Society for the Prevention of Cruelty to Animals, 105 Jermyn Street, London S.W.1, England.

Taxes and Royalties

DID you know that you need pay no state income tax upon patent royalties?

The United States Supreme Court, considering the petition of Henry F. Long, Commissioner of Corporations and Taxation of the Commonwealth of Massachusetts, against George J. Rockwood, has held recently that a state tax upon royalties received for use of patents issued by the Federal Government is prohibited by the Constitution. Such a tax, it holds, would amount to a tax upon the patent right itself.

"The power to exclude others, granted by the United States to the patentee, subserves a definite purpose—to promote the progress of science and useful arts," says Judge McReynolds. "The patent is the instrument by which that end is to be ac-

complished. It affords protection during the specified period in consideration of benefits conferred by inventor. And the settled doctrine is that such instrumentalities may not be taxed by the states.

"As United States patents grant only the right to exclude, our conclusion is not in conflict with those cases which sustain the power of the states to exercise control over articles manufactured by patentees, to regulate the assignment of patent rights, and to prevent fraud in connection therewith."

In a dissenting opinion Justice Holmes says:

"Obviously it is not true that patents are instrumentalities of the Government. They are used by the patentees for their private advantage alone. If the Government uses them it must pay like other people.

"The fact that the franchise came from a grant by the United States is no more reason for exempting, standing by itself, than is the derivation of a title to a lot of land from the same source."

Double Registry in China

CIVIL war in China naturally has had its effect on American firms doing business there. One government rules a large portion of the country from the ancient

capital at Pekin, while another directs a large and commercially important section with Nankin as its capital. This schism has resulted in the issuance of the following order:

"Notice is hereby given that all firms who have registered their trademarks in the Ministry of Agriculture, Trade and Commerce in Pekin and (or) with local authorities, must re-register such trademarks with the Nationalist Government on or before March 24, 1928, failing which, registration with the Pekin Government will be declared null and void, and future protection by law will not be guaranteed."

Since March 28 it has been necessary to register trademarks originally at both capitals in order to secure protection covering the whole of China.

The American Firm Wins

AT last an American manufacturer has succeeded in getting a court decision giving back to him trademark rights which had been appropriated by another in a foreign country. The trademark in question is "Fashion Park," registered by Rosenberg Brothers of Rochester.

In 1918, their Havana agent, Enrique Edelstein, registered the trademark in Cuba in his own name. Six years ago he

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Aeronautics

AIRCRAFT—With an auxiliary propeller which may be tilted at an angle to control the ascent or descent of the plane, also to aid in direct flight, or as an emergency power. Patent 1671865. K. Karish, 1559 E. 7th St., Brooklyn, N. Y.

SLACK BALLOON WITH ELASTIC DEFORMATION—Capable of automatically changing the volume of the balloon in dependence of the variations of internal or external pressure, without causing appreciable variations in shape. Patent 1671922. L. Avorio, c/o L. Labocetta, via Due Macelli 31, Rome, Italy.

Pertaining to Apparel

HAT—Which will actually be a hat of chic appearance for street wear, or an emergency waterproof covering for a turban, or small hat of the cloche type. Patent 1671890. R. E. Chaine, 415 Madison Ave., New York, N. Y.

CEREMONIAL VEIL—A bridal or confirmation veil constructed ready for wear, in order that anyone may don the same properly draped over the head, and properly ornamented. Patent 1671889. G. L. Dorros, c/o Dorros Bros., 1 East 83rd St., New York, N. Y.

LACE—With a special arrangement of draw string receiving loops, certain of the loops being omitted, to give the desired arc or curvature when drawn. Patent 1673629. J. Loopo, c/o Domestic Lace House, Inc., 2 E. 23rd St., New York, N. Y.

Chemical Processes

PROCESS FOR EXTRACTING METALS FROM METALLIC SULPHIDES—By means of which

sulphide ores, concentrates, and other metallic sulphide-bearing materials can be treated and the metals extracted therefrom in a practical manner. Patent 1671003. A. B. Bagsar, Box 3006, Huntington, W. Va.

PROCESS FOR EXTRACTING METALLIC NICKEL—Very suitable for recovering nickel from nickel-bearing solutions which are produced in copper refineries in the course of the electrolytic refining of copper. Patent 1671004. A. B. Bagsar, Box 3006, Huntington, W. Va.

Designs

DESIGN FOR A JEWELRY SETTING—Patent 75370. F. C. Joseph, 1316 Morris Ave., New York, N. Y.

DESIGN FOR A CAKE PAN OR THE LIKE—Patent 75427. S. Joseph, 23 East 22nd St., New York, N. Y.

Electrical Devices

ELECTRICAL TERMINAL—Which can be applied to the end of a stranded conductor and the bared ends securely wrapped and firmly held when applied to a binding post. Patent 1671905. E. D. McKenna, 81 Chambers St., New York, N. Y.

COMPOSITION—An electron emission element comprising a metallic core of comparatively high conductivity, and a coating on the core, the coating consisting of an oxysulphureted substance. Patent 1671007. H. L. Berger, 115 Palisade Ave., Jersey City, N. J.

ELECTRIC CUT-OUT FOR STILLS AND THE LIKE—Which includes means for breaking the circuit when the body of liquid in which the device is submerged is diminished to extent to uncover the fusible element. Patent 1672800. L. F. Boss, c/o Marine Biological Laboratory, Woods Hole, Mass.

lost the agency. Nevertheless, he has been able to prevent the sale of Fashion Park clothing in Cuba.

After a prolonged legal fight the American manufacturers have succeeded in obtaining an executive order ratifying the decision of the Bureau of Patents and Trademarks which canceled Edelstein's registration. This action is in accordance with the precepts of the Chile Convention for the Protection of Trademarks, of which both the United States and Cuba are signatories. Rosenberg Brothers may now sell their product in Cuba under their own trademark.

Britain Rewards Inventors

IN Great Britain a patentee who wishes to claim payment from the Crown for the use of his invention may either pursue his rights under the Patent Act or apply for an *ex gratia* award. In the former case he files his claim and establishes that his patent is valid and has been infringed. Should he fail to prove his case he has no redress.

On the other hand, he may abandon his patent rights and apply for the *ex gratia* award. The Crown admits neither validity nor infringement, but, if the inventor proves that he made the invention, that the Crown used it, and that there is a causal connection between the making and the using by the Crown, then he may be given an award in accordance with the equities in the case.

Such awards as the government has made in the last two years are listed in a report to Parliament from the Royal Commission on Awards to Inventors. Sixty-seven claims have been dealt with and a number of substantial awards made. Among them are the following:

Peter Brotherhood, Limited, 25,000 pounds for improvements in internal combustion engines.

The Electric Boat Company and others, 12,880 pounds for improvements in submarines.

Messrs. Vickers, Limited, 7500 pounds for wind-balanced ring mountings.

A. E. A. Dagory, 3500 pounds for a method of decoppering guns.

Metropolitan Vickers Electrical Company, Limited, 4000 pounds plus royalties, for wireless reception apparatus.

A. I. Caquot, 3000 pounds for the Caquot balloon.

Norman A. Thompson, 3000 pounds for improvements in flying boats.

The New London Ship and Engine Company, 2000 pounds for Diesel Engines for submarines.

C. Chilawsky and P. Langrin, 2000 pounds for improvements in signaling.

Women Inventors Increase

INVENTIONS by women are increasing more rapidly than those made by men, according to a report made by the Children's Bureau of the Department of Labor, after an investigation of patent office records covering a period of ten years. The second five years have shown an increase of 85 percent in the women's output over the first five years, as against a less than 17 percent increase on the part of the men inventors.

Of the more than 5000 patents issued to women in the ten-year period, the greatest number in any one class, 1385 were for household inventions, and the next greatest, 1090, were for articles of personal wear and

CRYSTAL DETECTOR—Having universal movement with respect to its co-acting electrode so that a very large range of selectivity can be had, and means for holding the electrode against movement. Patent 1670589. F. J. Martin, 4050 Maple Ave., Oakland, Cal.

PULL-CHAIN TERMINAL—For electric lights, made from light material such as thin sheet brass, but so constructed that it is strong enough to resist a tension strain. Patent 1672929. J. J. Cook, 1230 So. Wabash Ave., Chicago, Ill.

VARIABLE CONDENSER—For radios, whereby the possibility of current losses is reduced to a minimum, the manufacturing cost lowered, and the assembly rendered extremely simple. Patent 1673213. T. W. Sukumlyn, 1543½ East Washington St., Los Angeles, Calif.

Of Interest to Farmers

BROODER—In which ample fresh air will be supplied at all times, and the heating means beneath the brooder cannot result in injury to the chicks. Patent 1671039. I. Mead, R. F. D. No. 1, Rockford, Ill.

HONEYCOMB FOUNDATION—Of the type known as "extracting" frames, constructed of a tough composition of hard fiber, in place of wax usually employed in the practice. Patent 1672853. H. L. Settle, Payette, Idaho.

EGG TRAY—Having a movable egg-supporting bottom and stationary individual egg holders, for properly turning and positioning the eggs in an incubator, at all times. Patent 1672774. C. T. Patterson and H. W. Young, c/o Moisture Guide Co., Springfield, Missouri.

Of General Interest

BUILDING BLOCK—Formed of cementitious material, embedded and in surrounding relation with a metallic reinforcing frame incorporated in the walls of the block, and substantially the same shape. Patent 1671893. V. E. Easterday, Sr., Box 646, Urbana, Ill.

METHOD OF PERMANENTLY STRAIGHTENING KINKY HAIR—Which leaves it straight without the use of any grease, acid or listerine, so that the owner may have a clean head and permanently straight hair. Patent 1671857. J. W. Embrey, c/o Dr. R. Caldwell, 831 New Donaghey Bldg., Little Rock, Ark.

IRONING BOARD—Adapted to be attached to a closet door, will occupy very little space and may be readily extended in operative position at any desired angle. Patent 1671881. C. E. Barrie, 6 Water St. Extension, Plymouth, Mass.

HAIR WAYER—Characterized by convenience of assembly, operation and control, as well as being constructed not to strain or injure the hair being "marcel" waved. Patent 1672775. W. J. Perkins and E. Hagemeister, c/o Mrs. Emma Hagemeister, 58 Chancery St., Astoria, L. I., N. Y.

COLLAPSIBLE BOX—Of the type used for the shipment of suits and cloaks, having additional strength and rigidity to prevent collapsing condition when in use. Patent 1671029. M. Feinberg, c/o Ritt & Goldman, 191 Joralemon St., Brooklyn, N. Y.

ATTACHMENT FOR HOUSEHOLD REFRIGERATORS—Which may be connected and supported within an open door of a refrigerator, for collecting chips of ice which have been removed from the block. Patent 1670959. S. G. Garrett, 604 Atlas Life Bldg., Tulsa, Okla.

NURSING-BOTTLE HOLDER—Which may be conveniently attached to a baby carriage or other suitable support and adjusted to dispose the bottle at the proper angle. Patent 1671085. T. Nuernberg, 214 Hope Ave., Passaic, N. J.

GRILLE—Constructed to permit the occupant of an apartment to observe applicants for entrance without opening the door to an intruder. Patent 1670948. G. W. Ackerman, c/o Ackerman Door Interviewer Co., 211 W. 231 St., New York, N. Y.

use. The list also includes, however, 221 patents in agriculture, forestry, and animal husbandry, 228 in manufacturing, 208 in structural materials, 345 in transportation, 378 for supplies for use in industry, agriculture, commerce, and the home, 227 in medical, surgical, and dental equipment, 211 in amusement, 129 in safety and sanitation, and the remainder scattered through such fields as mining and smelting equipment, steam laundries and firearms. There are even nine inventions by women for fishing tackle.

As inventors women still lag behind the men, with only 2 percent of the total number of inventions to their credit in the ten-year period. Their productivity, however, is increasing twice as fast as that of the men, and it is possible that at some distant date the two sexes may be displaying equal ingenuity.

Invention Without Knowledge

CAN an inventor obtain a patent upon an invention which he does not fully understand?

Such was the question presented recently for solution in the infringement action brought between the United States Industrial Chemical Company against the Theroz Company in the Circuit Court of Appeals for the Fourth Circuit. The Theroz Company as assignee was operating under three patents, two issued to Jacob Schaub and one to Henry M. Brigham. The patents cover an artificial fuel, popularly known as solid alcohol. It is said to have supplanted the "canned heat" manufactured and sold by the Sterno Corporation during the years 1914 to 1920 and until the Sterno Corporation began to infringe the patents of the Theroz Company.

When the Theroz Company sued the United States Industrial Chemical Company and the Sterno Corporation for infringement, the Federal District Court of Maryland held the two Schaub patents valid and infringed and held the Brigham patent void on the ground that it was anticipated by the Schaub patents. When the case came up on appeal, the attorneys for the Industrial Chemical Company contended, among other things, that Schaub's patents were not valid because of his ignorance with respect to the fact that it is the acetone in commercial ethyl alcohol which is the solvent of nitrocellulose and that it is the water contained in commercial ethyl alcohol which is a coagulant.

"We are not impressed with the argument," Judge Parker held. "Schaub was experimenting with alcohol of the commercial grades; and if through such experiments he discovered a way to attain the result which he was seeking, and correctly described it in his application for a patent, it makes no difference whether or not he understood the chemical theory or the natural laws underlying the process. A partial enumeration of the great inventions and discoveries which have involved the use of forces and elements not understood by the inventors themselves would unduly lengthen this opinion. And if it be true that Schaub stumbled upon an important invention without understanding the reasons for what he had accomplished, it will not have been the first time that truth has been withheld from the wise and learned and revealed to the humble seeker."

After disposing of a number of other contentions, the decision upheld the decrees of the District Court.

TOOTHBRUSH—Having a ball or spherical-shaped brush which fits any conformation of teeth and will effectually clean inner and outer faces of the teeth. Patent 1671891. J. A. Dolan, 55 Spooner St., Floral Park, L. I., N. Y.

PORTABLE BARBER'S CHAIR—Especially designed for use in hotels or clubhouses, capable of being readily moved to the room of a customer, yet immovable when occupied. Patent 1671556. S. Sterling, Los Angeles Biltmore, Los Angeles, Calif.

SURFACE CLEANER—So constructed as to present surfaces and edges which will conform to the contour of cooking utensils, or similar household articles, to be cleaned. Patent 1672818. L. F. M. Lea, Billop Ave., Tottenville, S. I., N. Y.

SOAP HOLDER FOR BRUSHES—Which permits the application of soap to the surface being cleaned, yet allows the normal use of the brush in scrubbing the surface. Patent 1671348. V. F. Creegan, c/o Postal Telegraph Co., Albuquerque, N. M.

CLEANING DEVICE—In the form of a brush, having a concave depression at the rear for holding a roll of cleaning fabric, for removing spots or otherwise cleaning garments. Patent 1672772.

H. A. Mund, 150-37, 121st Ave., Baisley Park, Jamaica, L. I., N. Y.

Hardware and Tools

STAPLE—Whose prongs are reinforced to facilitate the piercing of the material, and which obviates the bending of the prongs in the fastening operation. Patent 1671895. J. Fritz, c/o Fritz Tabor Mfg. Co., 17 N. Water St., New Bedford, Mass.

FASTENING DEVICE—A supporting member especially adapted for use in holding a fire place front cover in place, may be adjusted for holding the fastening taut. Patent 1670995. J. H. Sutton, La Grange, N. C.

VICE—Comprising but relatively few parts, with facilities for gripping and firmly holding a piston, or like article, without causing injury to the outer surface. Patent 1672808. J. J. Hansel, Fremont, Mich.

STEAM-BOILER-CLEANING TOOL—A fork, one tine of which is provided with a roller, the other with a cutting point, adapted for scraping parts or walls of a boiler. Patent 1672757. S. Gabrielse, c/o Nederlandsch Oetroot-Butran, 31 Laan Copes Van Cattenburch S. Gravenhage, Holland.

Heating and Lighting

DAMPER REGULATOR—Designed for automatically controlling the dampers of boiler flues of low pressure systems, whereby the dampers are gradually opened or closed, instead of instantly. Patent 1671892. C. H. Dutcher, c/o Messrs. Kielly & Mueller, 34 W. 13th St., New York, N. Y.

AUTOMATIC DAMPER—A normally open damper, with an adjustable counter balance, adapted to be closed by the draft through a flue whenever the draft exceeds a predetermined minimum. Patent 1672758. A. Given, 201 N. Elm St., Toppenish, Wash.

ADJUSTABLE BRACKET FOR LAMPS—Which is artistic in appearance, may be adjustably positioned on a standard, and conveniently removed for replacement, is inexpensive to manufacture. Patent 1672794. A. J. Tizley, c/o E. F. Caldwell Co., 36 W. 15th St., New York, N. Y.

Machines and Mechanical Devices

METHOD OF AND DEVICE FOR CEMENTING WELLS—Especially designed for use where a plurality of oil producing sands are to be protected against cavings, or the down flow of water, by means of cementation. Patent 1673616. A. Boynton, 1800 San Pedro Ave., San Antonio, Texas.

ICE-FREEZING TANK—In which a greater tonnage of ice is produced with a smaller total footage of coils, the relatively short coils being easily removable for repair. Patent 1671945. H. P. Fell, c/o Dry Milk Co., 15 Park Row, New York, N. Y.

SECTIONAL PACKING GLAND AND WASHER—Which may be assembled on a shaft or other mechanical element without taking down the shaft or removing objects mounted thereon, particularly adapted for windmills. Patent 1671909. J. F. Struble, 225 East "B" St., Hutchinson, Kansas.

CONNECTING ROD—Wherein the usual lining is eliminated at both ends, and the parts surrounding the crank shaft are adjustable to take care of wear without bushings. Patent 1671859. —H. N. Gundelach, 157 W. 103rd St., New York, N. Y.

OPTICAL LENS GRINDING AND SURFACING MACHINE—For grinding and surfacing both spherical and cylindrical lenses, the motions being automatic after proper settings are once made. Patent 1671027. H. A. George, c/o Steele & Tipton, Attys., Superior, Wis.

DISHWASHING MACHINE—Which will automatically wash, rinse and steam dishes, and will automatically at predetermined intervals introduce a fresh fluid into the machine. Patent 1670611. E. L. Couch, c/o Couch & Dean, 250 Park Ave., New York, N. Y.

SCRAPER FOR WRINGERS—A structure wherein the wringer may be used intermittently or continually, and which will prevent the clothes passing through the wringer from adhering to the rollers. Patent 1672824. H. L. Morin, 6011 John R St., Detroit, Mich.

FIDDLE SNATCH BLOCK—Intended for the leads of both the main falls and topping lift on a hoisting derrick, taking the place of the two blocks commonly employed. Patent 1672823. T. A. McMillan, c/o W. H. McMillan & Sons, 49 South St., New York, N. Y.

EXTRACTOR FOR LAUNDRIES—Which provides means, involving the minimum amount of labor and time, for squeezing the water from clothes, without twisting or entangling the same. Patent 1671913. M. Troy, c/o Cascade Steam Laundry, 835 Myrtle Ave., Brooklyn, N. Y.

Medical Devices

APPLICATOR—By means of which a predetermined amount of medicine may be deposited within the vagina adjacent the uterus, without any backflow. Patent 1670605. E. S. Acilts, Little Rock, Iowa.

URINAL—Which will be a convenience to invalid male adults, or infants, adapted to be applied to a person, and may be connected with another container. Patent 1672748. C. J. Bruner, 288 North 4th St., Columbus, Ohio.

NOSE AND MOUTH SHIELD FOR DIAGNOSTIC REFLECTORS—Capable of being adjustably associated with a head reflector, such as are worn by opticians or physicians, in illuminating the eyes, or throat. Patent 1671842. J. J. Cantor, 512½ Lucas Ave., Los Angeles, Calif.

Musical Devices

MUSICAL INSTRUMENT—Having a vibratile member and means whereby the pitch of the member may be changed, permitting the playing of tunes from a special sheet of music. Patent 1671882. W. Bartholomae, 7913 Bay Parkway, Brooklyn, N. Y.

Prime Movers and Their Accessories

FUEL MIXER—An interceptor, adapted to insure a complete separation of all unvaporized or liquid fuel from the column of air and vapor about to enter the combustion chamber. Patent 1671897. S. S. Gentile, 400 Louisville Ave., Monroe, La.

POWER PLANT—Which eliminates all reciprocating parts, is not subjected to bearing friction, produces a constant torque, provides effective scavenging and utilizes any known motive agent. Patent 1670953. M. I. Browne, Delia, Kans.

SPARK PLUG—Having means for automatically holding the sparking terminal, irrespective of the rotation movement of the points of contact, and means for cooling the terminal. Patent 1672956. C. A. Schreiber, R. No. 1, Cedar Lake, Ind.

Railways and Their Accessories

TIE AND FASTENER—So constructed that a single set of parts may be differently adjusted to provide insulation or non-insulation, reinforcement or non-reinforcement, yet permitting a firm clamping action. Patent 1670994. J. G. and A. N. Snyder, c/o Keystone Metal Tie Co., 441 Lexington Ave., New York, N. Y.

VALVE FOR AIR-BRAKE SYSTEMS—An angle valve which will provide for a safer handling of trains, either during movement or when necessary to disconnect for making repairs. Patent 1670950. J. Bell and W. H. Sagstetter, 441 Ewing Ave., Decatur, Ill.

Pertaining to Recreation

AMUSEMENT APPARATUS—A receptacle adapted to hold liquid, and to be penetrated by small missile, the flowing liquid releasing balls, by the action of gravity, to a scoring board. Patent 1671000. H. S. Weinstein, 480 Jefferson Ave., Brooklyn, N. Y.

TEETER—Or See-Saw, which is so made that it may be used either to rotate, or see-saw, or converted into a slide. Patent 1672754. W. B. Delisle, 313 Benton Ave., Springfield, Missouri.

Pertaining to Vehicles

ATTACHMENT FOR STEERING RODS—Which will not only maintain the parts associated with the rod from rattling, but will prevent the rod from slipping from its connections. Patent 1670954. W. E. Coleman, 211 Lake St., Shreveport, La.

AUTOMOBILE BODY CONSTRUCTION—Designed for touring purposes, and so constructed that sleeping quarters may be provided by the lowering of hinged platforms constituting portions of the sides of the body. Patent 1671457. G. P. Wiedman, c/o Weidman Body Co., No. Tonawanda, N. Y.

SIGNAL—For pneumatic tires, an audible, automatic signal, controlled by a spring in opposition to air pressure in the inner tube for giving warning of the loss of air. Patent 1671852. W. A. Caldwell, Box 576, Manila, Philippine Islands.

HEADLIGHT—Providing the maximum efficiency, at the same time, eliminating glare, the device being inexpensive to manufacture, the reflector forming part of the framework. Patent 1671900. W. Irwin, 342 Madison Ave., Flushing, L. I., N. Y.

AUTOMOBILE SIGNAL DEVICE—Which may be operated by vacuum action created by the engine to project a signal into view from a car, such as a sedan. Patent 1671200. M. C. Merrill, Flaxton, N. D.

RECOIL MECHANISM—Designed to eliminate the sudden checking of the upward rebounding movement of a vehicle body, and allowing a normal elevation without jerking movement. Patent 1671410. C. M. Cronkhite, 1345 Graynold Ave., Glendale, Calif.

MOTOR-VEHICLE BUMPER—Rigidly constructed side bumper with rubber shock absorbers, especially built for hard collisions, and particularly adaptable on taxis and buses. Patent 1665536. W. A. Dierker, 359 Dean St., Brooklyn, N. Y.

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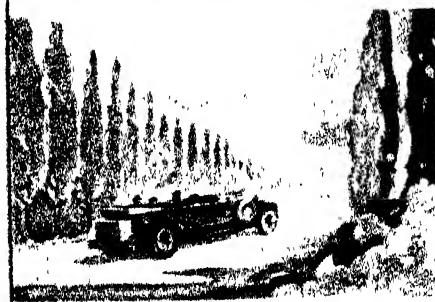
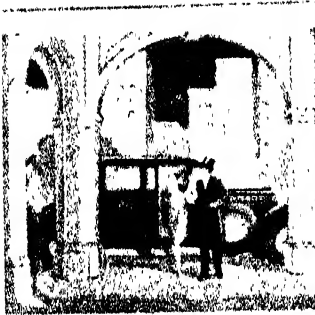
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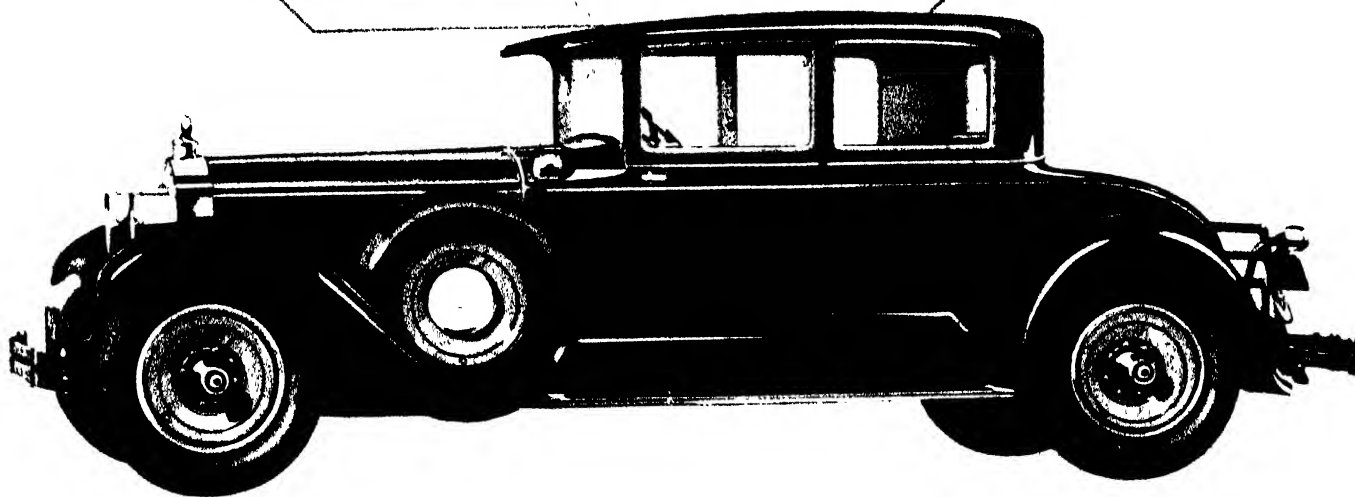


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Chandler	Special 6	x	x	x	x	x
Chrysler	Big 6 & Royal 8	x	x	x	x	x
	52 62 72	x	x	x	x	x
Cunningham	80	x	x	x	x	x
	All	x	x	x	x	x
Dodge	All	x	x	x	x	x
Durant	4-M2 and 55	x	x	x	x	x
Eclair	65 & 75	x	x	x	x	x
	6-70	x	x	x	x	x
Falcon	8 78, 8 82	x	x	x	x	x
	8 91, 8-92	x	x	x	x	x
Ford	All	x	x	x	x	x
Franklin	All	x	x	x	x	x
Gardner	All	x	x	x	x	x
Graham-Paige	610	x	x	x	x	x
	614	x	x	x	x	x
Hudson and Essex	619, 629, 835	x	x	x	x	x
	All	x	x	x	x	x
Hupmobile	Big 8	x	x	x	x	x
Jordan	Century 8	x	x	x	x	x
Kiesel	All	x	x	x	x	x
Kleiber	All	x	x	x	x	x
LaSalle	All	x	x	x	x	x
Lincoln	All	x	x	x	x	x
Locomobile	8 70	x	x	x	x	x
Marmon	68	x	x	x	x	x
	78	x	x	x	x	x
McFarlan	All	x	x	x	x	x
Moon	All	x	x	x	x	x
Nash	Std 6	x	x	x	x	x
Peerless	6 and 8	x	x	x	x	x
	8-69	x	x	x	x	x
Pierce-Arrow	6 91, 6 60	x	x	x	x	x
	and 6-80	x	x	x	x	x
Reo	81	x	x	x	x	x
	36	x	x	x	x	x
Roamer	Flying Cloud	x	x	x	x	x
	Wolverine	x	x	x	x	x
Stearns-Knight	All	x	x	x	x	x
Studebaker	All	x	x	x	x	x
and Erskine	All	x	x	x	x	x
Stutz	All	x	x	x	x	x
Velie	All	x	x	x	x	x
Willis-Overland	Whippet 4	x	x	x	x	x
	Whippet 6	x	x	x	x	x
	56	x	x	x	x	x
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	70-A	x	x	x	x	x



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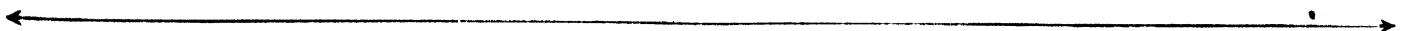
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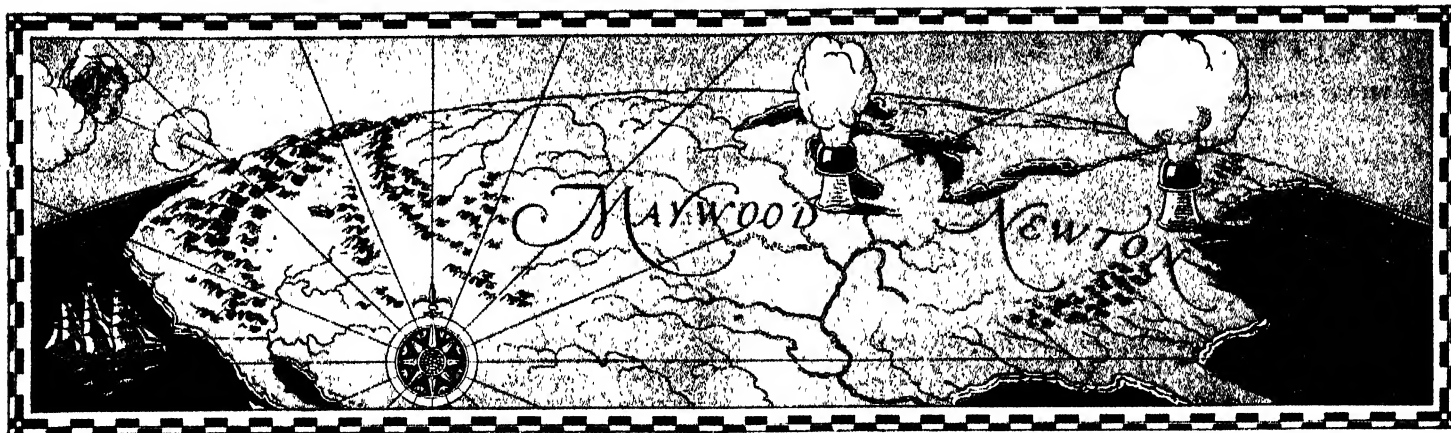
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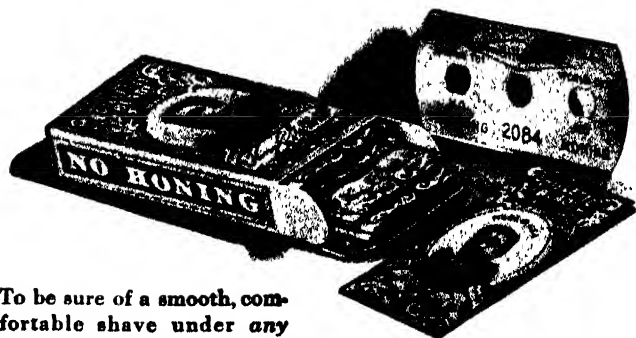
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Eighty-fourth Year

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COVER

The Southern Pacific Railroad decided to re-build seven Mallet type locomotives to facilitate freight movement through the Rockies. Our cover this month shows the first of these rebuilt locomotives to be finished, "with the hind part before," as described on page 350.



Timken Steel for Timken Bearings

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THE TIMKEN ROLLER BEARING CO., CANTON, OHIO

OF THE 40 MANUFACTURERS OF PASSENGER CARS IN THIS COUNTRY, 35 USE TIMKEN BEARINGS AT THE POINTS INDICATED BY CROSSES

MAKE	MODEL	Front Wheels	Rear Wheels	Pinion	Steering Differ- ential	MAKE	MODEL	Front Wheels	Rear Wheels	Pinion	Steering Differ- ential
Auburn	All	x	x	x	x	Kleiber		x	x	x	x
Cadillac	All	x	x	x	x	LaSalle	All	x	x	x	x
Chandler	65	x	x	x	x	Lincoln	All	x	x	x	x
	Big 6 & Royals	x	x	x	x	Locomobile	8-70	x	x	x	x
Chrysler	De Soto	x	x	x	x	Marmon	68	x	x	x	x
	Plymouth	x	x	x	x		78	x	x	x	x
	65 & 75	x	x	x	x	McFarlan	All	x	x	x	x
	80	x	x	x	x	Moon	All	x	x	x	x
Cunningham	All	x	x	x	x	Nash	8-66	x	x	x	x
Dodge	All	x	x	x	x		8-69	x	x	x	x
Durant	4-M 2 and 55	x	x	x	x	Peerless	6-91, 6-60	x	x	x	x
	65 & 75	x	x	x	x		and 6-80	x	x	x	x
	6-70	x	x	x	x	Pierce-Arrow	81	x	x	x	x
Eicar	8-78, 8-82	x	x	x	x		36	x	x	x	x
	8-91, 8-92	x	x	x	x	Reo	Flying Cloud	x	x	x	x
Falcon	All	x	x	x	x		Wolverine	x	x	x	x
Ford	All	x	x	x	x	Roamer	All	x	x	x	x
Franklin	All	x	x	x	x	Stearns-Knight	All	x	x	x	x
Gardner	All	x	x	x	x	Studebaker	All	x	x	x	x
	610	x	x	x	x	and Erskine	All	x	x	x	x
Graham-Paige	614	x	x	x	x	Stutz	All	x	x	x	x
	619, 629, 833	x	x	x	x	Vette	All	x	x	x	x
Hudson and Essex	Century 6	x	x	x	x	Willys	Whippet 6	x	x	x	x
	Century 125	x	x	x	x		36	x	x	x	x
Hupmobile	Century 8	x	x	x	x	Overland	65-A	x	x	x	x
Jordan	All	x	x	x	x		70-A	x	x	x	x
Kissel	All	x	x	x	x			x	x	x	x

TIMKEN *Tapered* BEARINGS *Roller*

Looking Ahead With the Editor

Just Sitting or Standing

WHEN you sit, do you just sit? When you stand, do you just stand? Do you ever consider your posture? Why not? Working efficiency and health are vitally dependent upon the way in which you hold your body when sitting or standing. If either your posture or carriage is incorrect, you want to know about it, don't you? Then read what a psychologist who has studied posture has to say in a future issue.

Man's Greatest Mechanical Invention

OFFHAND, what would you say it is? It is not modern by any means, for it dates back some 5000 years. It is the wheel. Wheels compose a part of practically every vehicle used by man today and there is scarcely any kind of machinery that does not use them. Thus it can be seen that there is much romance behind them. A scholarly study of their mechanics, with other information about them, is coming soon.

Paleolithic Man in Ireland

MR. J. REID MOIR, well-known to SCIENTIFIC AMERICAN readers, tells in a forthcoming article of the discovery of artifacts on the wild coast of County Sligo. The finder and Mr. Moir contend that they are paleolithic; others deny the possibility. Each side gives its reasons and the battle rages, for it is scientifically important if Old Stone Age man did inhabit Ireland. Read the article; form your conclusions.

A Question in Economics

MOST people picture the great northwest of Canada as a bleak, frigid, and barren territory. As pointed out in an article now ready for publication, however, it has tremendous possibilities. The development of rapidly maturing wheat is pushing the wheat belt farther north; meat-producing herds of reindeer will soon abound; and musk-ox, buffaloes, and many other animals provide food and clothing. The territory promises to become a vital factor in world economics.

Anomaly Island

SO does the author of an intensely interesting article now ready for release, choose to designate Dominica. When Columbus landed, the native men spoke a tongue different from that of the women. At the present, it is the home of a myriad of bats, the imperial parrot, lizards that snap their tails off when attacked, fishes that live out of water, and many other anomalous creatures. It is a scientist's paradise.

Every Issue Fully Illustrated

The well-informed man or woman is the one who progresses. Why not let the SCIENTIFIC AMERICAN bring to you the latest news of the scientific world in general? The cost is nominal—only four dollars for an entire year's subscription.

Among Our Contributors

Tassilo Adam



Dr. Adam, late ethnographer to the Dutch-East Indian Government, recently visited this country and lectured in New York and other places on his remarkable experiences in Sumatra and Java. Dr. Adam combines a purely scientific interest in primitive peoples with what might be called a popular interest in what he observes. Also he has a sense of humor.

Carl J. Warden

In the Animal Laboratory, at Columbia University, Dr. Warden studies the reactions and behavior of many kinds of animals. In this issue he contributes an enlightening article concerning the psychology of the dog. Dr. Warden's theories are as sound as scientific study and research can make them.

Sir George Knibbs

Sir George Knibbs is a famous statistician. He has made a study of population growth and is altogether competent to handle the greatest problem of the future—the overcrowding of the earth. Oddly enough, he comes from Australia where the present problem is to obtain a larger population. He has held many vital positions with the Australian Government.

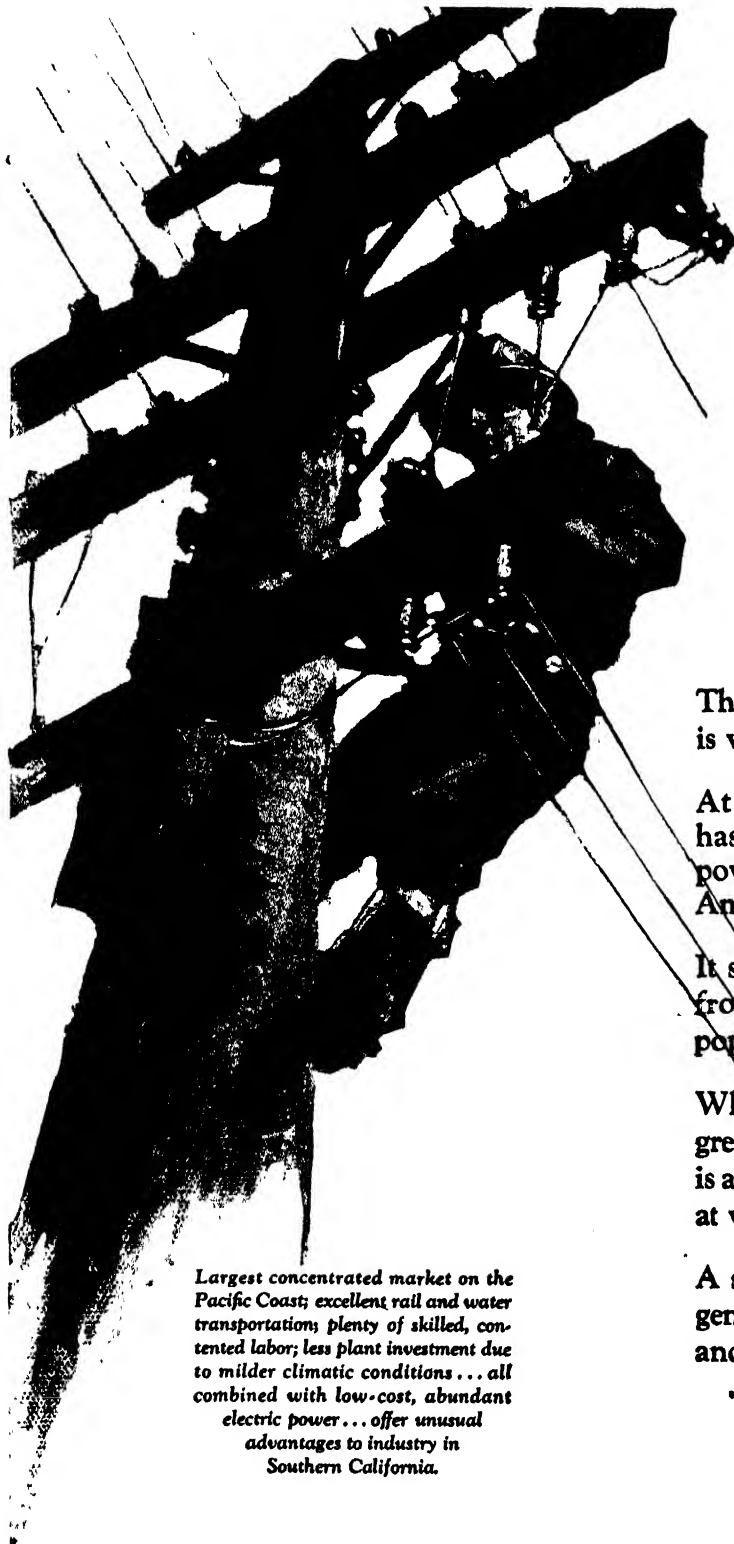


Clyde R. Keith

Since coming to the Bell Telephone Laboratories in 1922, Mr. Keith has been engaged in a study of the properties of vacuum tubes and other non-linear electrical conductors, with regard to their use for modulating high-frequency waves with voice currents. Such devices, called "modulators," are used in multiplex telephone systems.

W. L. Calver

Mr. Calver is a superintendent of mechanics for elevated railroads on week days, but on Sundays he is always off digging up Indian relics, or anything else he can find at old garrison posts and battlefields. His thoroughness as a practical archeologist led to his being chosen to direct the exploration of Montfort, a crusader's castle in Palestine.



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Charles Francis Brush

AMONG the pioneers of applied science in America, few have attained higher honor and distinction than Charles F. Brush. In 1878 he gave to the world the famous Brush electric arc light and the practical storage battery. During the last 40 years Mr. Brush has devoted all his spare time to research in pure science and has contributed many significant papers to scientific societies. He is a member of many engineering and scientific bodies and the holder of many honorary degrees from institutions of learning. In 1881 he was decorated by the French government for

"Distinguished Electrical Achievement." In 1899 he was awarded the Rumford Medal by the American Academy of Arts and Sciences for "The Practical Development of Electric Arc Lighting." In 1913 he was the recipient of the Edison Medal of the American Institute of Electrical Engineers. In 1928 he was awarded the Franklin Medal by the Franklin Institute for "The Early Development of the Arc Light and the Broad Invention of the Practical Storage Battery;" also, The Cleveland Chamber of Commerce awarded him the Cleveland Medal for "Distinguished Public Service."



Photo by Spencer and Wyckoff

Fellow

FELLOW, the interesting subject of the article starting on the opposite page, is a pedigree dog, but there is no reason to believe he began life equipped with especially abnormal innate intelligence. His abilities are mainly ascribed to the fact that he was reared as the children of intelligent people are reared; that is, he was talked to by his owner about as much as one ought to talk to a developing child, and in

grown-up language. As a result, he now reacts to a wide variety of spoken language. Fellow obviously associates certain sounds with definite responses, but it is a question among psychologists whether the response to human adult language is not much the same kind of thing. A rather technical account of Fellow's responses to verbal stimuli will be found in a recent number of the *Quarterly Review of Biology*.



JACOB HERBERT AND FELLOW

Mr. Herbert of Detroit has made a hobby of fine dogs for years. Fellow, now five years old, has a long line of famous ancestry behind him. Mr. Herbert does not claim that Fellow reasons as human beings do

The World of the Dog

Dogs Are Often Blamed for Shortcomings Really Due to Fundamental Differences of the Senses.

How Would It Seem to Be a Dog?

By PROFESSOR C. J. WARDEN

The Animal Laboratory, Department of Psychology, Columbia University

ALMOST everyone has wondered at times what sort of a world his favorite dog, or other familiar pet lives in. Naturalists and philosophers have indulged in endless speculation regarding the matter, and numerous attempts have been made to draw realistic pictures of just how the world must seem to infra-human forms.

In general, two opposing principles have guided such speculations. Some writers have followed the tack of humanizing the so-called "mental life" of animals, and particularly the higher mammals. Others have sought to interpret their behavior along narrowly mechanistic lines, holding it to be very different indeed from the higher mental life and behavior of the genus *homo*. The former tendency is best illustrated in the writings of the anecdotalists who flourished for several decades after Darwin, while the latter view is exemplified in the position of Descartes

and of Loeb with his theory of tropism. Speculations of this sort are no longer held in good repute by sober scientists. Animal psychologists have long since ceased to trouble themselves about matters pertaining to the subjective life of lower organisms. They now speak of the behavior of the animal to the various sorts of stimuli that together constitute the animal's environment, after the manner of the behaviorist in human psychology.

THEY are interested in finding out what stimuli arouse the organism and how it responds to such stimuli, since such knowledge will lead to the ability to predict and control its behavior—and this is the primary purpose of psychology.

It is indeed quite possible to give a comprehensive psychological account of an animal without appealing in any way to human mentalistic terms. The capacity of an organism to be stimu-

lated by different energies and objects in varying degrees and its ability to adjust itself as a whole to its multiform environment include a wide range of problems that can be tested out by appropriate experimental methods in the laboratory and in the field. Fortunately, it is precisely such information as the behavioristic psychologist seeks to obtain concerning animal behavior that will answer the queries of the common man concerning his favorite pointer, or the monkey that may attract his attention at the zoo.

There is no better way to get an understanding of this new psychological principle than to see just how it is applied in a given case. And we have chosen the dog for purposes of illustration because of the general interest in this species which has been so intimately connected with the social life of mankind since long before the dawn of written history.

What do we know concerning the

ability of the dog to see, hear, smell, and in other ways sense the objects which constitute its everyday world? How does the world of dog and man differ insofar as they live in a common world? What evidence of intelligence, using that term in a broadly biological sense, does the dog exhibit in fitting into the somewhat arbitrary scheme of man's life? To what extent, if at all,

make a generalization regarding a given capacity that will be more than approximately true for the canine species as a whole. This difficulty is greatly enhanced by the fact that the tests for one capacity have been made on one breed and the tests for another capacity on another breed. This factor of racial and individual differences is also met with in human psychology although it

the olfactory lobes of the brain. Naturally the animal makes use of the more highly developed sensory mechanism and thus comes by force of habit to make exceedingly fine discriminations as compared with those of the other less-developed senses.

The dog follows the trail to lee-ward when the wind is blowing. Trails a few hours old are not easily followed since the odorous substance left by the foot of the animal tends to diffuse until it becomes wholly dissipated in the air. The crossing of trails often causes confusion, although the trail can usually be picked up again quite readily. It has long been known that a dog cannot trail a man by smell through the snow if the man's boots from which the scent is taken are carefully encased in paper while the man is walking along.

It was accidentally discovered in the laboratory that the dog can detect which of two electric grids is charged, presumably by the slight amount of ozone given off in the one case, and thus avoid stepping upon the charged plate and getting a shock. In general it may be said that whereas man hardly notices the odor of an object unless it is markedly pleasant or unpleasant, the dog lives and moves and has his being in a world of smelly objects.

IT is now definitely known that the dog does not see very well, probably possesses no color vision, and hence sees everything as some shade of grey. The retina of the eye is poorly developed, the fovea which man uses in fine visual work being absent and numerous opaque nerve fibers showing through as blind areas. The dog is somewhat inferior to man in distinguishing between the intensity of two lights, and very much inferior in the matter of discriminating between objects of different sizes and shapes. The dog is extremely far-sighted and apparently uses vision mainly in making gross reactions to distant, moving objects.

Sight thus plays a secondary role in the adjustment of the animal to the external world, whereas it is of primary importance in the space-world of man.

The auditory capacity of the dog appears to be quite similar to that of man insofar as ordinary sounds are concerned. The dog can usually hear well enough the sounds that his master can hear, including of course those constituting human speech. And here, the question arises as to what use the dog can make of the spoken language of man.

There can be no doubt but that the dog can learn to distinguish between the sounds represented by different spoken words which may come to serve as cues for specific forms of activity. The most outstanding instance of such ability so far noted is that of the Ger-



MR. HERBERT—MR. FORD—FELLOW

Mr. Herbert estimates that Fellow knows about 400 words and that he understands these words much as a small child would understand them—that is, as signals for determining his behavior

does the dog understand and make use of the system of symbolic stimuli which is represented in human language? Some attempt has been made by the animal psychologist to solve these and similar problems, although the present treatment must necessarily be sketchy and tentative.

IN the first place, we must recognize the fact that different breeds of dogs differ markedly in respect to any one of a number of capacities. Certain breeds, for example, are superior to others in visual, auditory, or olfactory capacity, and most certainly in general intelligence. Not only so, but individuals within any one breed differ in these respects much more widely than is commonly supposed.

It is very difficult, therefore, to

has been pretty largely ignored until lately.

In discussing the world of the dog we may well begin with the sense of smell, for the common assumption is quite true that the dog lives predominantly in a world of odorous objects. More tests have been made on olfactory sensitivity than upon any other of the senses. Many of these tests have been made in the open and deal with the practical use of the sense of smell in trailing. The common belief that the dog possesses a much more acute sense of smell than does man has been in general upheld by these tests.

There is nothing mysterious, however, in the unusual ability of the dog to trail game, or man himself as in the case of the bloodhound. The organ of smell is highly developed, as are also

man shepherd male, Fellow, whose ability along this line was recently subjected to critical tests in the animal laboratory at Columbia.

Mr. Herbert, owner of Fellow, has talked to the dog for several years past very much as one talks to a child during the earlier months of taking on language. The dog is now able to perform scores of requests, or commands, when given in a purely hit and miss order with his master quite out of sight behind a screen, or in another room. He can also do very well at retrieving a particular object upon request when required to go into another room and pick it out from among three objects placed in a row. Such a task is really more difficult than it may seem, especially when done under test conditions which differ from those under which the animal has been trained.

AS is well known, the supposedly mathematical stunts performed on the stage by dogs, horses and other animals, involve nothing more than a highly developed ability to react to minute gestures, or changes in facial expression, often unconsciously exhibited by the trainer. The feat of Fellow went far beyond anything of this sort.

That the dog can make use of human speech-sounds need not mean that he can understand language in the sense in which an adult human being does. Nevertheless, the formation of associations between vocal sounds and specific objects and actions must certainly be one of the first steps in the process of taking on language in childhood. We need not concern ourselves with the academic dispute over precisely what is and what is not true language. It is quite enough to be able to say that Fellow, at any rate, has come to associate human speech-sounds

with definite objects and modes of response, and hence the language of his master enters in an important manner into his world.

How does the dog compare in intelligence with other species of animals? Such a comparison must always be more or less of a rough estimate and with our present limited knowledge of animal behavior would be only a guess. The training and testing of such a complex animal as the dog along systematic lines requires a large amount of time, almost infinite patience, and a well-equipped laboratory.

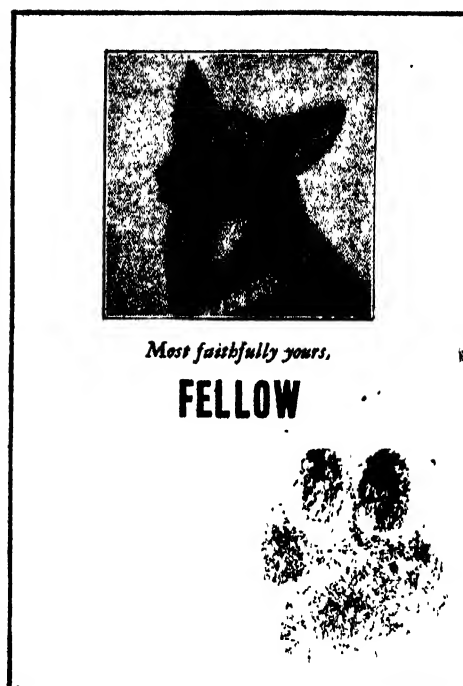
At the present time no really adequate laboratory for such animals as the dog exists anywhere, except, perhaps, that of Pavlov in Russia. Wealthy dog-lovers appear to be mainly sentimentalists who content themselves by declaiming from time to time on the loyalty of the dog to man without feeling called upon to shoulder the task of establishing research laboratories in which the dog's world might be investigated by competent animal psychologists.

The animal psychologist is amused at times by the naïveté of the dog lover who seriously asks for a scientific opinion as to the intelligence of his pet after a few minutes exhibition of simple tricks which a child might easily teach the dumbest mongrel. Again, he is annoyed at such an attitude, which is in reality an insult to dog intelligence, since it implies that the dog is so "simple minded" as not to require or justify extensive, and incidentally, expensive research.

SUCH tests as the psychologists have made, in spite of the serious handicap of lack of adequate laboratory facilities, suggest that the dog is probably one of the most intelligent of the higher mammals. Even an ordinary dog can solve problems requiring the successive operation of several simple mechanical devices, or finding the shortest way through a complicated maze in order to secure food. There is some evidence for supposing that the dog is far superior to the cat in intelligence, and not far below the raccoon and the monkey.

By intelligence we mean the ability of the animal to adjust itself to a changing environment, indicating the capacity to profit by experience. In practical life the dog certainly shows a relatively high intelligence in fitting so easily into the cultural life of man at so many points. With an adequate psychology of the dog at our disposal, some of the vexing questions that have arisen of late regarding the proper place and treatment of the dog in our larger urban centers should be more judiciously disposed of than they can be at present.

In comparing the world of dog and man, the most important differ-



Most faithfully yours,

FELLOW

FELLOW'S CARD

These "fingerprints" were made in the usual manner. They are reduced to half size

ence, aside from the obvious point of general intelligence level, would seem to be the predominance of smell in the dog and of sight in man. The dog's world presents a continuum of odorous objects, indistinctly seen and colorless, while the world of man is a panorama of colorful objects, more clearly outlined, but, for the most part, altogether odorless.

The fact that the dog is extremely far sighted should warn us against punishing him for mistakes that he cannot help making. Perhaps the dog makes more use of hearing than of sight, and if so would differ in this respect also from his master. Further studies ought to be made to see how far his ability to distinguish human speech-sounds can be carried. It is useless to attempt to train the dog to "talk" since his vocal equipment is unsuited to the making of articulate sounds.

IT is ridiculous to make hasty comparisons of the dog and child as to general intelligence. Specific performances might be compared, although as a rule children are not as yet being tested by the methods that have been developed in animal work.

It is not inconceivable that a common intelligence test for the pre-language child and such higher mammals as the dog, raccoon, and monkey might be developed in time. It might well be based upon general and specific motor aptitudes, sensory discrimination capacity, and the ability to respond to speech-sounds that had become associated with objects and activities common to these organisms and to the child.



Associated Press Photo

THE AUTHOR

He is shown giving Fellow a psychological test—not an easy thing to do on a dog



Why the Moon is Apparently Ahead of Its Computed Position

THE drawing shown above, reproduced from the *Illustrated London News*, is an attempt to depict graphically the gradual lengthening of the terrestrial day. With the Moon's position alone as our criterion this change might easily be ascribed to the Moon itself, but studies made by the astronomer Dr. Benjamin Boss and others, indicate that the other heavenly bodies agree with the Moon; therefore the source of the phenomenon must be confined to the Earth. The braking effect of water tides will doubtless account for most of the 1000th of a second per day per

century lengthening of the terrestrial day but in addition to this there is a definite variation or fluctuation in the length of the day over periods of only a few years. Professor E. W. Brown of Yale, a member of the staff of the *SCIENTIFIC AMERICAN*, believes this is caused by a periodic shrinking and swelling of the Earth, amounting to several inches; the shrinking causes increased rotation, by reducing the Earth's moment of inertia. Perhaps significantly, Professor Boss has traced a definite relationship between the variations in rotation rate and earthquake frequency.

OUR POINT OF VIEW

Lightning and Airplanes

APART from its great interest to scientists and electrical engineers, the intensive study of lightning now being conducted by engineers of the Westinghouse Electric and Manufacturing Company in a mountainous region of the south where lightning is known to be of frequent occurrence, may prove of extreme importance to aviators. Captain Carranza, the Mexican flier, and others, have recently been killed by what is thought by some to have been mid-air lightning strokes.

Theoretically, if a plane should pass between two clouds so highly charged that the tension is about to break down in a vivid flash, the plane's metal sheath or parts might so lower the resistance between the clouds as to cause a discharge from one to the other. The results might possibly be the same were the plane to pass under a cloud of which the electrical tension is at a critical point in respect to the earth beneath. In either case the plane that disrupted the static balance would be not only in the path, but would be an actual part of the path, of the stroke. Naturally this would spell disaster for the plane and its pilot.

So far, however, science theorizes on this subject—makes no positive statements. In the meantime airplanes roar their way through rain and storms with apparently little thought of dangerous electrical surges in the atmosphere. And even if science finally decides positively that lightning constitutes a tremendous hazard for the flier, we doubt not that some more adventurous spirits of this highly adventurous calling will fly through storms rather than dodge them, merely for the delight of recounting hair-raising tales of "blue flames and the cannonading of the elements."

Efficiency's Goal

MEN work hard because they are lazy. A vision of leisure, with no necessity for doing anything save follow his whims, has been the impelling force which has made many a man tense his muscles and knit his brow far beyond the needs of the moment. Such labor, with well-earned idleness as the objective—idleness in the closing hours of the day or in the closing years of life—is responsible for much of the world's progress.

Now comes Dr. George Otis Smith, Director of the Geological Survey. Addressing a class of college men, he urges that some degree of efficiency would be desirable in the use of our leisure hours. "About all that can be said of some of our so-called recreations is that they

serve to kill time," he declares. "The question when and under what circumstances a private citizen is justified in committing time-slaughter may call for an opinion from some high court."

What a wonderful, wonderful system! We work efficiently to have leisure, and use our leisure efficiently so we can work better. But it is not original. It

D. C. Davies

THE average person has but a small conception of the duties of a director of a great museum of natural history. Generally it is thought that he must be a scientist. However, this is not necessary. He must first of all be a good executive, have an intense interest in science and something of an understanding of its problems, and must be able, so to speak, to "keep peace within the family" of curators under his directorship. Such a man was the late D. C. Davies, Director, until his death on July 14, of the Field Museum of Natural History.

"Mr. Davies filled the position of director with the utmost ability, and it is largely due to his excellent judgment and far-sightedness that Field Museum holds the high position in the scientific world that it now does, and has made such phenomenal growth," declared Captain Stanley Field, President of the museum, shortly after Mr. Davies' death.

In the death of this business man who successfully directed so great a museum, not only the museum itself but the scientific world at large, has lost an indefatigable worker whose efforts have done much to enlarge the scope of human knowledge. Let his work, then, be his monument; nothing could be finer.

is a clear infringement on the idea of the parent who gave his little boy a nickel for taking castor oil, and had him put it in the little tin bank, and when the bank was full they took out the money and bought a new bottle of castor oil.

The Modern Rage for the Occult

IT is astonishing to a person of scientific leanings to discover in this boasted "age of reason" how many millions of otherwise sane, level-headed, intelligent people still dwell, after a fashion, in the very midst of the Dark Ages. We refer to the recent craze for astrology, the "science" of the stars in their control over the destiny of human individuals. One need only visit the corner bookstore to learn that

there is at present an enormous sale of books on this subject; it has broken into the ranks of the very best sellers.

Astrology was the parent of astronomy, but when astronomy came of age it parted company with the parent, ashamed of its origin. And well it might be. Chemistry was sired by alchemy, whose age-long quest for the elixir of life and the transmutation by some magic formula of base elements into gold formed the creed of a virtual religion—a faith. Chemistry long ago shuffled off the last vestige of the medieval parental influence, but like astrology, alchemy still lives on.

The editor frequently receives from France a journal devoted to alchemy, the official organ of the Société Alchimique de France. From the same source comes a book, "The Chemical Fabrication of Gold," by Jollivet Castelot. By catalytic action Monsieur Castelot lays claim to the possession of the secret of manufacturing gold chemically "by acting on silver mixed with arsenic and antimony sulfides, tellurium and tin."

Not one whit more ridiculous than this, however, is the belief, sincerely held by some persons of the keenest acumen, that the stars exert a subtle influence over our lives. Do these good souls know what the stars are? Let them purchase a dollar book on astronomy, the offspring of their beloved occult study of subtle influences, and find out what sort of a thing is the Universe in which they live.

Coal and the Future

THERE is little romance, so it would seem, in bituminous coal; it is more dirty than romantic. Yet romance will be put into it by the technological developments of the new age of chemistry which are to be revealed at the forthcoming Second International Conference on Bituminous Coal, at Pittsburgh.

At the coming "conference," which is really a convention, technologists from all the Old World countries, especially from chemical Germany, will assemble. These are not so much coal men as scientists who expect to use coal as a raw material for other things. For example, we shall have men who make fixed nitrogen from coal, rubber from coal, sugar from coal, and gasoline from coal. In short, the best technological brains in the world will be present at the Carnegie Institute of Technology in Pittsburgh between November 19 and 24.

These Coal Conferences are likely to prove pivotal; a new age of wealth and luxury may begin with them.



International Newsreel

CRASH MASK

Mask and helmet worn by Les Barker, a motorcycle racer, at the recent opening of the Speedway Track at the Hove Sports Stadium in England



International Newsreel

WORLD'S LARGEST ELECTRO-MAGNET

Weighing 120 tons and having pole pieces in the form of truncated cones, this electro-magnet belonging to the French Academy of Science was fitted up for the National Scientific Research Office at Bellevue near Paris. It is to be used by research scientists for the further study of magnetism. There is still much to be learned on this subject

From the

Scrap-book

of Science



International Newsreel

◀ REPLACING THE HORSE

In America, few could imagine a horse being employed to perform such a task. However, on Prince's Pier, Melbourne, Australia, horses were formerly used to shunt cars about the yards. Now this small tractor does the work efficiently



Wide World

◀ X-RAY LIGHT

Fifteen feet tall, this giant million-volt X-ray tube—the world's greatest—has been perfected by Professors C. C. Lauritsen and R. D. Bennett of the California Institute of Technology, Pasadena. Capable of penetrating with its rays two inches of lead, it is to be used to seek information concerning the nucleus of the atom

MEASURING LIGHT ▶

Dr. L. R. Koller, of Schenectady, and the new daylight recorder he has developed. It is so sensitive that it can record the light intensities in the entire range between starlight and direct sunlight—a range of over a million foot-candles or lumens. The huge photoelectric cell on top of the case is the sensitive eye that starts the work. Fluctuations of the light that is being studied are recorded on the roll of paper shown



Underwood and Underwood



P and A

OVER THE PANAMA CANAL

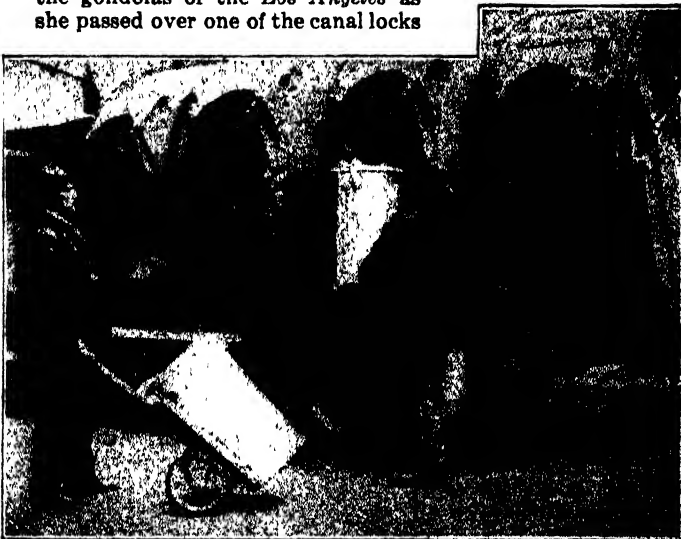
Interesting view taken from one of the gondolas of the *Los Angeles* as she passed over one of the canal locks



International Newswire

MACHINE SENDS 1000 WORDS A MINUTE

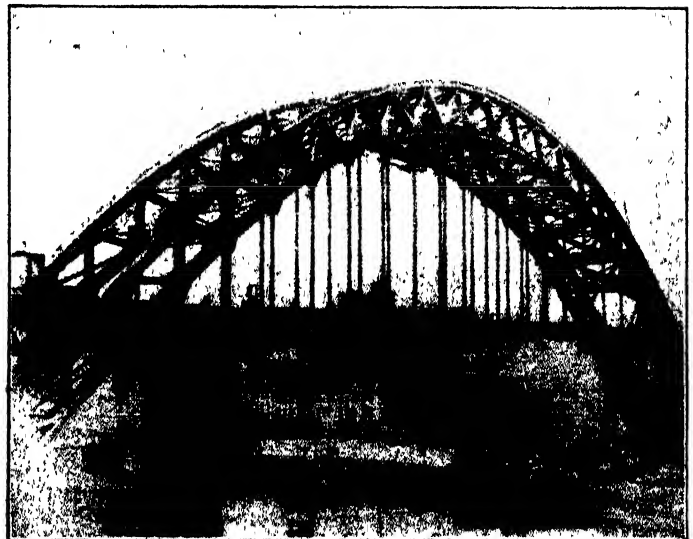
M. A. Noss, electrical engineer, operating the new automatic Telepost telegraph machine which will transmit 1000 words a minute. It is claimed that the machine is so nearly automatic that an inexperienced person can operate it with ease



P and A

LONDON'S NEW DUSTLESS REFUSE CARTS

The menace of ash dust and exposure of garbage has been eliminated in London by the introduction from Germany of these new trucks. Collections can be made at the rate of 180 bins an hour. The truck body is a cylindrical tank



P and A

ENGLAND'S LARGEST SPAN BRIDGE

Now nearing completion, this new bridge over the Tyne, to relieve traffic between Newcastle and Gateshead, is said to be the largest ever built in Great Britain. It has a span of over 500 feet and will cost about 5,000,000 dollars

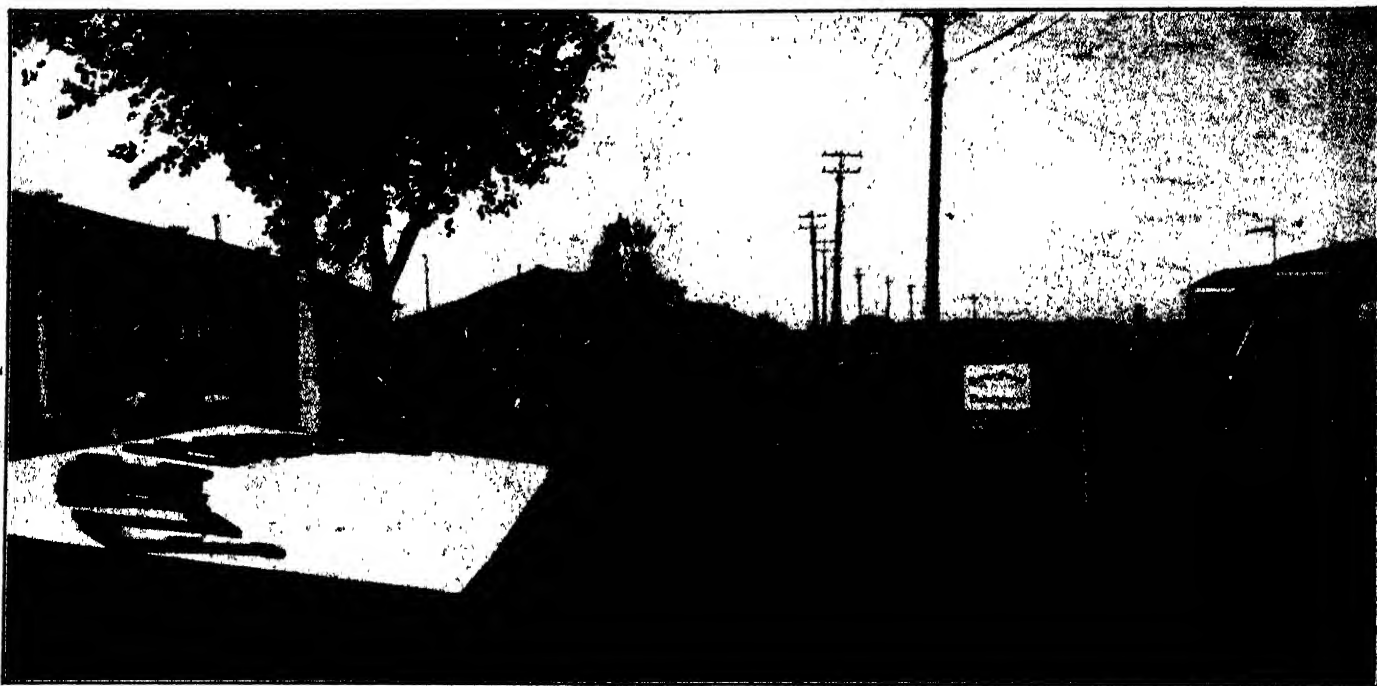
**◀ COLORIMETER**

Using a series of lenses, a lamp giving light many times more intense than sunlight, and a block of magnesium carbonate—the whitest substance known—as a basis of color comparison, this new machine for measuring color has been developed by Professor A. C. Hardy and F. W. Cunningham of the Massachusetts Institute of Technology

TEPEE MONUMENT ▶

This unique memorial to the Ute Indian chief, Ouray, and his squaw, Chipeta, was built of concrete at Mont Rose, Colorado. It covers the spring from which Chipeta carried water to their camp





All Photographs Courtesy U. S. Army Air Corps

ARRIVAL OF "FRESHMEN:" FUTURE PILOTS

A group of men arriving at the Primary Flying School after having successfully passed the rigid examinations. These men are physically perfect, mentally alert, and psychologically fitted to become pilots; and they enter into this new and hazardous life with great zest and eagerness

Youth Hankers to Fly

Tired of Being Earth-bound, Many Young Men Are Learning to Fly at Uncle Sam's Expense

By F. D. McHUGH

NOTHING in recent years, perhaps, has captured the popular fancy more than aviation. It presents to all a fascinating, adventurous career, and many young men are therefore wondering just how they may learn to become aviators.

Aviation today is in a very healthy condition. The World War first showed the effectiveness of airplanes and induced a great desire on the part of nations and individuals to excel in the production of airplanes and in the making of various air records. This intense interest has done much toward placing aviation on a safe and efficient basis, although there is still much to be learned. The newer generation of aeronautical engineers and fliers will no doubt solve a great many questions that now puzzle the industry as a whole.

SINCE Lindbergh's memorable flight from New York to Paris, which served to stimulate a more widespread interest than any other one incident, aviation has gone forward under the force of a great impetus, so that now there is no part of the world that is not "air conscious." Air mail, passenger, and air express lines are rapidly reaching out to all corners of the earth; air-

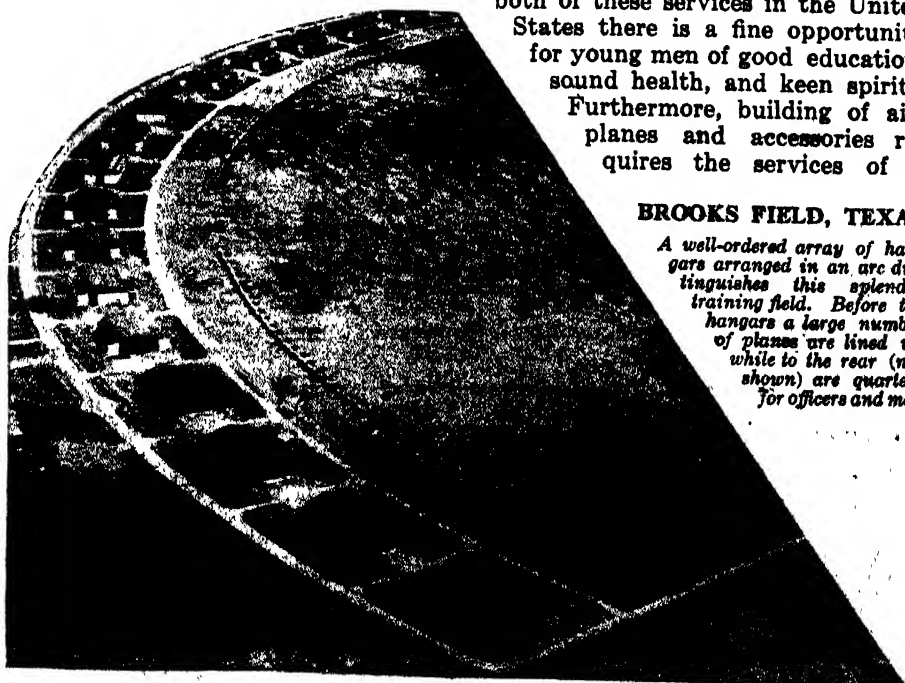
planes are being used for exploratory work as in the case of several proposed Antarctic flights; the Pennsylvania Railroad has planned and will soon place in operation a new transcontinental service in which planes will form several links; and but recently the New

York Central has announced tentative plans for a similar service.

The War and Navy Departments of all governments are naturally interested in airplanes because of their success while still in a crude state of development during the World War. In both of these services in the United States there is a fine opportunity for young men of good education, sound health, and keen spirits. Furthermore, building of airplanes and accessories requires the services of a

BROOKS FIELD, TEXAS

A well-ordered array of hangars arranged in an arc distinguishes this splendid training field. Before the hangars a large number of planes are lined up while to the rear (not shown) are quarters for officers and men



large number of competent designers, test pilots and the like, since there is a special demand for men who, in addition to their engineering qualifications, are also competent pilots.

The Regular Army Air Corps is in need of a large number of new officers, and offers a splendid career for those whose inclination is toward military aviation. To meet this demand the Air Corps maintains a group of flying schools where training is given, at government expense, in piloting aircraft. Graduate flying cadets possessing the necessary qualifications will have an excellent chance to obtain a commission in the Regular Army Air Corps.

"**G**REAT fliers are born and not made," according to the statement in a bulletin of the Air Corps. "The ability to fly well—to become a satisfactory military pilot—requires a certain combination of psychological attributes not required by any other activity or effort of man. The majority of men, and even the majority of men *who desire to fly*, do not possess these attributes."

The flight surgeons attached to the Air Corps, all of whom are specialized psychiatrists, have worked for many years on the problem of determining whether or not a man is a born pilot. Their records show that more than 25 percent of all candidates fail in this regard after having passed all other examinations. Therefore, it can readily be seen that the choice of flying as a career is no more a hit-and-miss proposition than would be the choice of any profession by a young man.

If you are between the ages of 20 and 27, have satisfactorily completed at least two years of college work or can pass an examination equivalent to this, have unimpeachable character, sound physique, and excellent health,



FINAL INSTRUCTIONS BEFORE THE FLIGHT

An instructor pilot giving a few final words of advice to the flying cadet before the take-off on a flight. Note: the training plane is larger and more sturdy than those that were formerly used

it is possible for you to obtain an appointment to the Air Corps Flying School. Men with the above qualifications, whether enlisted in the Regular Army, members of the National Guard Air Corps, members and graduates of R. O. T. C. units, or civilians, may be appointed.

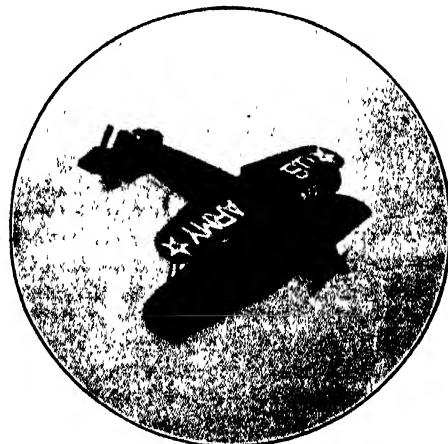
Although applicants may receive either heavier-than-air training or lighter-than-air training (balloon or airship), we shall consider in this discussion only the airplane course of instruction which lasts one year.

THE first eight months of this course are given at a primary flying school of which there are two—one located at Brooks Field, San Antonio, Texas, and the other at March Field, Riverside, California. On completion of the primary training the students are transferred to the Advanced Flying School at Kelly Field, San Antonio, Texas, for the remaining four months of the course.

The Adjutant General, Washington, D. C., will forward to applicants those documents necessary to execute an application properly. These consist of an application blank and an affidavit, both of which are to be returned properly filled out and accompanied by documents authenticating the applicant's education. When this application has been received and approved the applicant is notified to appear before an examining board at some one of a large number of stations, that are conveniently sit-

uated throughout the United States.

On appearing before the examining board, all applicants must first pass a rigid physical examination. This is to determine not only those who are not physically normal, but also those having defects or diseases which might become aggravated by flying, or which



DOING A BARREL ROLL

To be sure this is not trick photography, note the shadow thrown on the upper wing

would increase the flying hazard. The second part of the examination consists of an inquiry into the applicant's education. This is omitted if the applicant submits documentary evidence as to graduation from or the satisfactory completion of two years' work at a recognized college or university. For those not so exempt, the general scope of the educational examination will cover United States history, geography, arithmetic, higher algebra, plane and solid geometry, plane and spherical trigonometry, and elementary physics. Having successfully passed these, the applicant then takes the psychological test. In this, the flight surgeons give practical tests to determine the applicant's reaction



OVER GATUN LAKE, CANAL ZONE

Army pilots are assigned to various stations throughout the world where they see from the air much picturesque country



HOW A PARACHUTE WORKS

Wind from an anchored airplane (not shown) opens a parachute for the cadets

time under various stimuli; a test on the Ruggles orientator which simulates the evolutions performed in flying; and a personality analysis.

Individuals who are accepted for flying training in the Air Corps are appointed "flying cadets," a grade which was created by Congress in 1919. Flying cadets have special uniforms and are quartered in separate barracks provided for them. They are extended the social and military privileges of potential officers, constituting as they do a body of young men who are noted for their splendid character and excellent discipline. Physical exercise is not only included in the curriculum but the cadets are encouraged to make the fullest use of the swimming pools, tennis courts, and other facilities provided for keeping them in good physical condition.

THE environment is in every way maintained at a standard to be fully in keeping with the gentlemanliness and education of the cadets and the dignity of the service in which they are enlisted.

The pay of a flying cadet is 75 dollars a month and his ration allowance is one dollar a day. Uniforms and equipment are furnished without cost. Flying cadets are transferred from the point of their enlistment to the flying schools, and from the flying schools to their homes, at Government expense.

The courses of training at the Primary Flying Schools start on July 1st, November 1st, and March 1st of each year. At these schools the cadet will receive instruction in piloting airplanes, will go through all the maneuvers in which a pilot should be competent, and, on completion of his

course, will have to his credit 75 hours in the air. At the same time he will receive a broad ground training consisting of an extensive study of airplane engines, navigation, machine guns, and radio. Besides these technical subjects, he will be given instruction in various academic subjects. This training as a whole not only broadens the cadet mentally, but also gives him an intimate knowledge of the equipment which he will use.

HAVING successfully completed the eight months' course at a Primary Flying School, the cadet is then transferred to the Advanced Flying School for the remaining four months of his course. He has been receiving instruction in training planes only, but at this school he will use the regular service planes. The

flying training is now more specialized since already he will have completed practically all the ground work necessary. He will do cross-country flying, will receive practice in aerial gunnery, and will participate in pursuit, attack, bombardment, and observation flights.

When the cadet has successfully completed the entire one-year course at the training center, he will be rated an "airplane pilot" and will be classed, without any further examination, a second lieutenant in the Air Corps Reserve. At this time he will have approximately 250 hours in the air to his credit.



OPENING

Unusual view of a jump from an airplane high in the air. The small chute opens first and drags the larger parachute from its pack



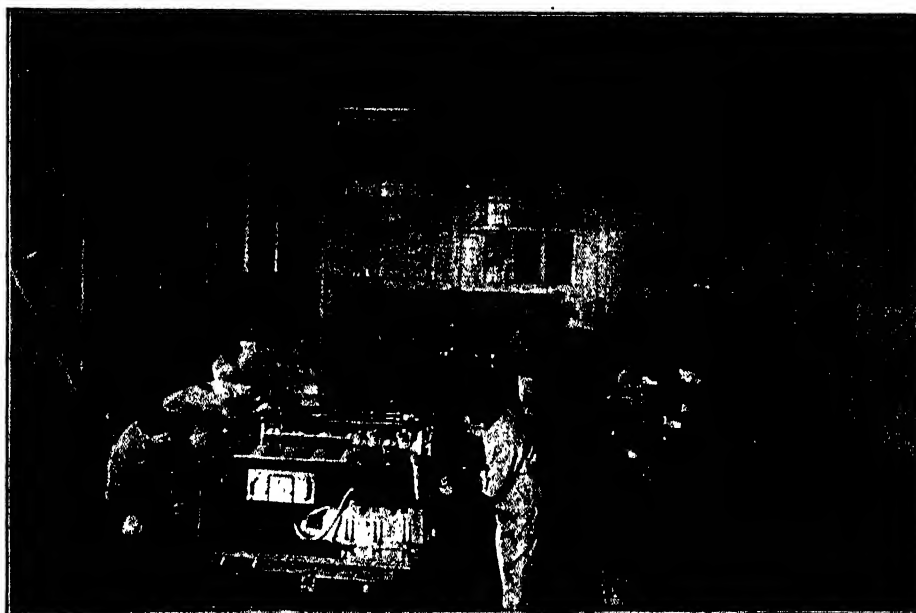
LEARNING HOW TO FOLD PARACHUTES

Since a human life may depend on the proper unfolding of a parachute in the air, the technique of folding these life-savers is an exact science. Cadets are here studying the method of folding

Within the limit of appropriation all graduates are then offered duty for a year with the Army Air Corps as second lieutenants. Eventually, it is thought that it will be possible to continue all officers of outstanding ability for a longer period if they so desire. While on this duty they have the privileges, pay, and allowance of a second lieutenant in the Regular Army. This additional service is invaluable to men who contemplate taking the competitive examination held each year to fill vacancies in the grade of second lieutenant, Regular Army Air Corps.

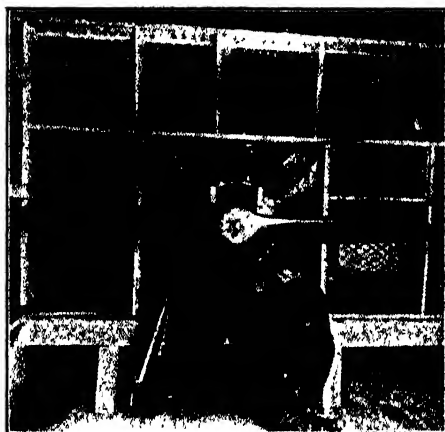
If the graduates do not desire to remain on active duty they are free to return to their homes and their normal civilian pursuits. With the inevitable expansion of aviation, however, many positions in commercial aviation will be open to these graduates. They will be assigned to reserve units in their localities and may report for active duty for two weeks each year if they so desire. While on this active duty, they will be permitted to fly all types of Government aircraft that may be available and on which they are competent. During the remainder of the year they will be allowed to fly Government airplanes at Government flying fields at no expense to themselves.

THE training offered by the Air Corps is an opportunity for which many young men have been looking, and there is no doubt but that commercial companies will recruit many pilots from the graduates of this school. In this connection, youthful aviation enthusiasts who have their hearts set upon becoming fliers, should be warned against the commercial type of school which offers to obtain for them a pilot's license after they have had only 10 or 20 hours in the air.



A GROUND SCHOOL CLASS

Testing battery ignition units, Department of Mechanics, Air Corps Technical School, Chanute Field, Illinois. The flying cadets go through similar courses but in a less-specialized manner



TESTING A WHIRLWIND

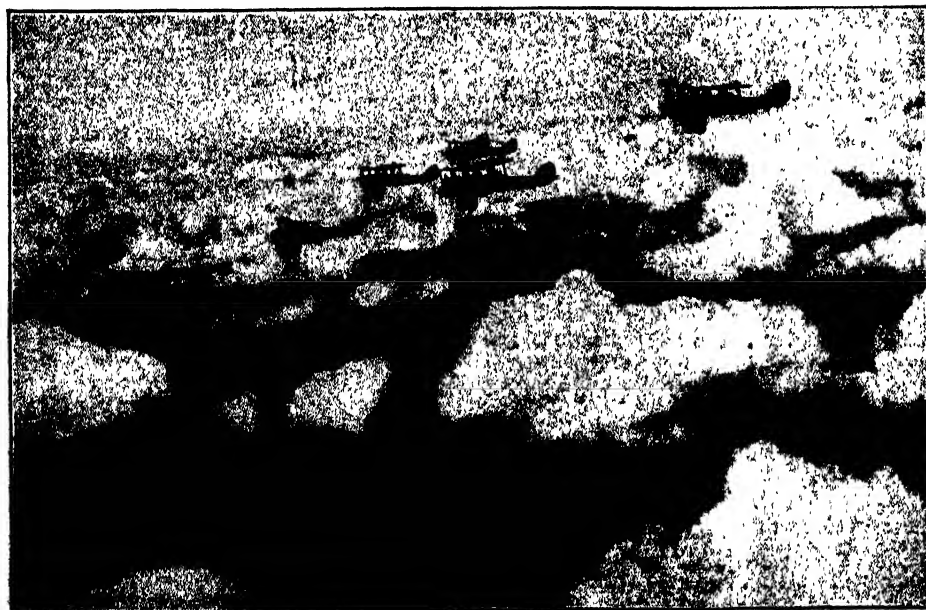
Students of the Technical School making a test of the famous Wright airplane engine

Field managers for commercial air transport companies report that they do not consider employing a pilot until he has had at least 500 hours in the air. Some of them limit this condition to solo flying, while others specify that out of 500 hours the pilot should have at least 300 hours over water. Naturally, in every case, such a pilot should know navigation, meteorology, and a great deal about different types of planes.

Besides the flying school described above, the Army Air Corps maintains a technical school at Chanute Field, Illinois. The purpose of this school, which has demonstrated its worth over a period of 10 years, is to train officers and men in the subjects of air communications, photography, aircraft armament, and airplane maintenance engineering. It was organized in order to supply the tactical organizations of the Air Corps with enlisted men properly trained in technical and aeronautical trades to carry on the work of the Air Corps most efficiently.

IT was demonstrated conclusively early in the World War that some method was necessary whereby enlisted men could receive standardized training in such trades.

Students for the Air Corps Technical School are selected by organization commanders throughout the army, each station being allowed a certain quota for each class according to its size, requirements, et cetera. In making these selections, commanding officers are guided by the qualifications of the individual, including his aptitude for the type of training to be given. Civilians, however, are not admitted to this school as enlistment in the Army Air Corps is necessary in order to obtain this training.



FLYING SERENELY ABOVE THE CLOUDS

Flight of R. O. T. C. students of the Massachusetts Institute of Technology, from Langley Field, Virginia, to Bolling Field, Washington, D. C. Note the stretches of field and forest far below

World Astronomers Meet

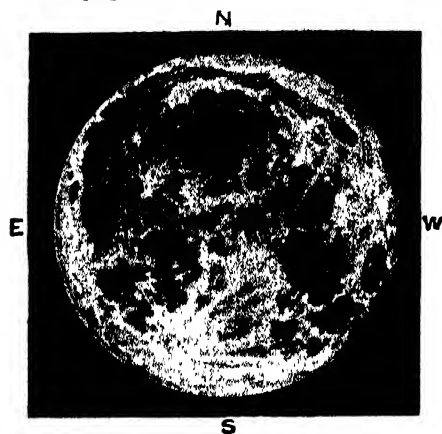
Every Six Years an International Convention of Astronomers Is Held. What Kind of Affairs Are Transacted at These Cosmopolitan Gatherings?

By HENRY NORRIS RUSSELL, Ph.D.

*Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mt. Wilson Observatory of the Carnegie Institution of Washington*

THE writer of these lines has just returned from a great meeting of astronomers from all parts of the world—that of the International Astronomical Union. Held in the ancient university town of Leiden, it brought together for a week of common council in Holland some 250 workers in astronomy and the allied sciences from more than 20 different countries.

The popular idea of the proceedings



THE MOON WITH NAKED EYE

Astronomical telescopes never show objects in this manner. Various optical elements invert them, reverse them, pervert them or erect them, leading to no little confusion

of such a conference appears to be rather far astray. The question which the writer is perhaps most often asked, for example, is, "Did you read a paper there?" Such an inquiry is not unreasonable, for at the meetings of individual learned societies such as the National Academy of Sciences at Washington, or the Royal Society at London, the presentations of communications upon the new scientific work is the main business. The same is true of societies which deal with a single science, such as the Royal Astronomical Society and its peers in other countries.

BUT at the Leiden meeting only a single session lasting less than two hours was thus occupied; and this, although crowded with condensed accounts of excellent work, was but an incident of the program. The main work of the modern international unions is of quite a different sort and is done mainly in committee. Leaving to

the various national and technical societies the discussion of the details of scientific advance, however interesting, the international bodies busy themselves mainly with those matters upon which general agreement to work on a common basis is desirable in the interests of science.

Their work is really execution; and in consequence much of their time is spent upon matters of apparently a formal nature such as the adoption of standard values for certain constants of a uniform notation and the like. For example, at the Rome meeting six years ago a set of three-letter abbreviations for the names of the constellations was approved which has already saved astronomers a good deal of money in printer's bills. In this, as in other cases, the action of the union is not mandatory. It cannot compel anyone to adopt the proposed notation, nor does it desire to do so. The system which has received the stamp of general approval will naturally be very widely used; all that is asked of the believers in some other is that they explain clearly in their published papers just what their own terms mean.

BEFORE telling what detailed work the Leiden Conference accomplished, it is a pleasure to speak of its most important feature. For the first time since the Great War a meeting of astronomers was fully and completely international. Formal technicalities even now have delayed the official entrance into the union of representatives of the "enemy powers" of a decade ago; but scientific good-will has outrun technicality and many German astronomers were present at the meeting, sitting with the committees at their sessions and cordially welcomed throughout. Complete international co-operation in the future is thus assured, to the profound satisfaction of everyone.

To attempt to catalogue specifically what the Conference did would dissipate the happy impression in a multitude of dry details. But it may be of interest to those who follow the doings of astronomers to hear of some samples of the work. First we may mention some of those things which, although purely formal, are of practical usefulness. The Committee on

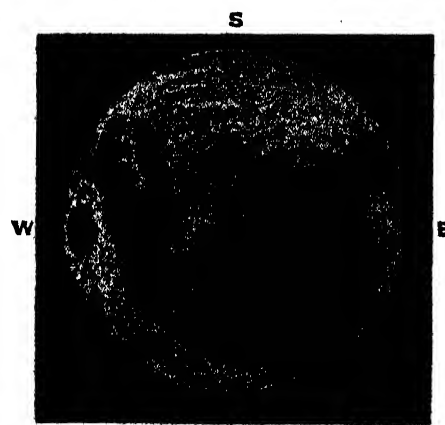
Notations recommended that whenever astronomical photographs are published, the north, south, east and west points of the field of view be marked upon the edge of the plate. Only those who have turned from one work of reference to another in the (perhaps vain) effort to find out which side of a picture of some nebula should rightly be placed up, can appreciate the full value of this policy.

AGAIN, the Committee on Bibliography requests that all observatories which issue serial publications, sending out the volumes of their transactions sometimes in several successive parts, should state clearly at the end of each part whether more is to follow or whether the volume is completed. Librarians will bless them for this.

Again, they urge upon authors that in citing references to other scientific papers they shall give full data; for example, not only the number of the volume of a journal but the year of publication. If this is done a misprint in one place such as the volume number will not leave the reader who wished to consult the original paper hopelessly at a loss to find it.

These may seem small matters to take up the time of a gathering of men from 20 nations; but the gain in efficiency which results from a steady attention to details like this is by no means small.

Another group of actions deals with

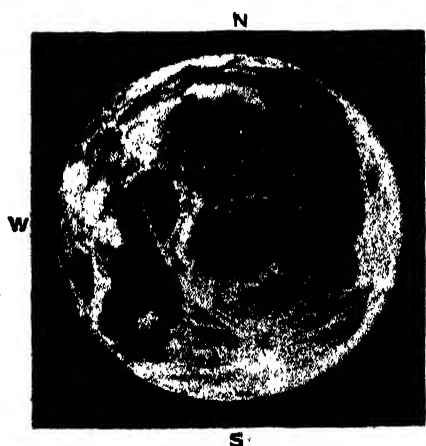


INVERTED AND REVERSED

An ordinary astronomical refracting telescope turns every element of the object into its opposite. An extra pair of lenses will correct this—but at a certain loss of light

the adoption of standards of measurement or notation. Here we meet with reports of but a few pages length which represent literally years of work. For example, the Committee on Standard Wavelengths gives a list of about 800 lines—bright lines in the spectrum of iron or of neon and also dark lines in the solar spectrum—which have been measured with great precision by several different observatories. The results are in excellent agreement and the mean values may be adopted as standards for further work. Says the report, "The uncertainty in the final results from iron is only about one part in five millions."

NO one who has not actually slaved over precise measurements knows fully what such a sentence means. First comes the laborious, careful designing and setting up of apparatus, the laborious measurement of the photographs and the still more laborious calculations. Then may follow perhaps the heartbreaking discovery after a year or two of work that the results of different investigators using different methods in laboratories thousands of miles apart disagree by one or two parts in a million. This leads to the painstaking search among all imaginable causes of the discrepancy and at last to its detection. When at the end the lurking sources of error have been removed, all that the International Conference has to do is to ratify the decision of the committee of experts and congratulate them on their success.



REVERSED AND ERECTED

This is a rare condition. The use of a diagonal with a refractor would bring it about. The Hartness turret telescope and the Gerrish telescope at Harvard, give this aspect. All drawings by Russell W. Porter

Other committees, meanwhile, have been busy with naming things which need labels of one sort or another. A Committee on Lunar Nomenclature has worked over the long lists of names which have been assigned to the mountains, craters and other surface features of the Moon and tabulated those upon which there is general agreement and the relatively few which have been given different names by two

or more authors. Here it is evidently not so important what names are assigned as that their significance should be definite. Only a report of progress has so far been made but perhaps by the next meeting of the union the matter will be decided.

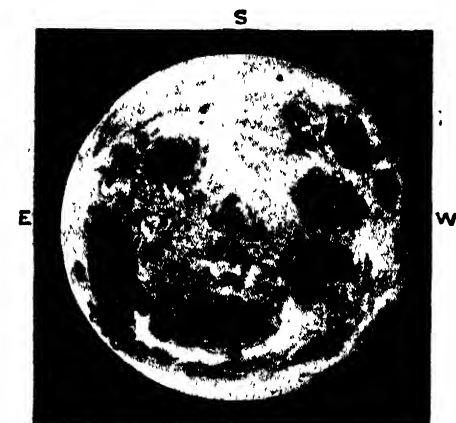
Similar questions had to be considered by the Committee on the Classification of Stellar Spectra which proposed a number of symbols to denote stellar spectra of different sorts. It would surprise the outsider to see what lively discussion sometimes arises in committee on such questions as, whether the presence of bright emission lines of metals in a star spectrum should be denoted by the letters "em" or by others; but the whole point of such meetings is to get such matters thrashed out. The final conclusions in such cases as the writer met with were often unanimous and when they were not, the minority accepted the result with an excellent good grace.

The needs of astronomy in the future also come under consideration. The funds at the disposal of the Union are limited, but appropriations of a few hundred dollars each were made to assist in the completion and publication of a considerable number of works such as a list of observatories and of the astronomers working at them, lists of variable stars in special need of observation, charts of solar phenomena, and the like.

A PARTICULARLY good example of the usefulness of a general gathering appeared when a request was made for observations of comparison stars for the asteroid Eros. This remarkable planet in 1931 will come very near the Earth and the opportunity of determining its parallax and hence the distance of the Sun will be exceptionally good. The observations like those of 1901 will doubtless be mainly photographic and every precaution must be taken to secure accuracy. The color of the planet and of the stars which are used as standards for determining its position will be a matter of importance. Light of different average color is refracted in the Earth's atmosphere by slightly different amounts, and if the color of the planet and the comparison stars are different, errors will creep into the final result. It was therefore requested that plans be made for determining the color of the planet and the colors and spectrum of the stars already selected as points of reference. Within five minutes after this matter had been brought up in committee, the directors of three different observatories all especially fitted to work on such problems had agreed to see that the desired thing was done.

Little space remains to tell of the things that were announced at the single session at which reports of new

work were made. Mr. Evershed, who, after long and useful service in India, has retired and set up an admirable private observatory at his English home, showed some noteworthy spectroheliograms of the Sun taken with infra-red light, using the great calcium line at wavelength 8542, in a region which a few years ago could not be



INVERTED AND RE-REVERSED

The diagonal mirror of a Newtonian reflecting telescope again changes the rays—but in one plane, only—in other words, the diagonal puts back to the naked eye aspect one of the two dimensions, but not the other

photographed at all. These lines are closely related to the great *H* and *K* lines in the violet, but the infra-red photographs to everyone's surprise showed much less conspicuous bright flocculi near the spots than those obtained with the violet lines.

Dr. B. H. Dawson—born in the United States but now working in Argentina—reported on a double star which he discovered four or five years ago. His observations, combined with those of Dr. Van der Bos in South Africa, shows that this is a binary with a period of only three years and a half—shorter than any previously known. Finally, mention should be made of work by Dr. Baade of Hamburg which indicates that certain faint nebulae which he has studied are at a distance of at least a hundred million light years.

THESE fragmentary glimpses from a full program may serve to give some idea of what astronomers talk about when they get together in force. Much more in the way of purely informal agreements, and of plans to bring the needs of younger workers of limited resources to the attention of the great foundations for the endowment of research, may better be suggested than told; but there can be no doubt that the Leiden meeting was a success.

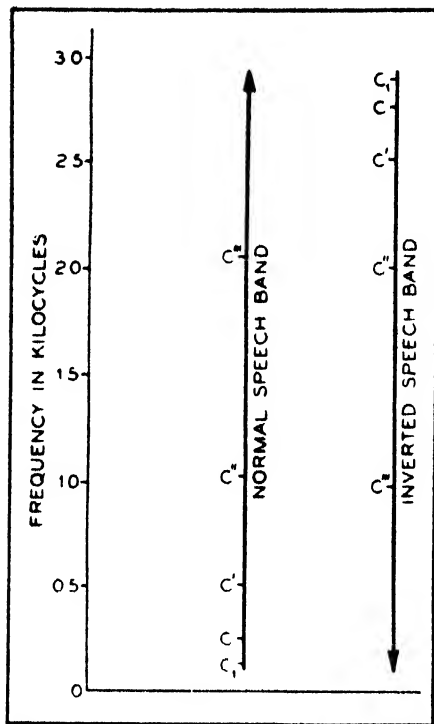
Keeping track of several hundred "pocket planets" is a fascinating pursuit, and finding new ones is a suitable pursuit for the amateur astronomer. Next month Dr. Russell will explain how this interesting work is performed.

New Languages from Old

How Secrecy Is Gained by the Inversion of Speech Sounds

By CLYDE R. KEITH

Research Department, Bell Telephone Laboratories



THE INVERSION

Figure 1: This shows how the normal speech band is inverted in the apparatus

IN translating spoken words from one language to another, the interpreter produces new sounds which are equivalent to those of the original language in meaning but quite different in physical make-up. If there were a definite physical relation between the sounds making up the words of one language and the sounds of the corresponding words in the other language, it should be possible by means of suitable apparatus to translate speech automatically from one language to another.

Since there are no such definite relations between existing languages, no mechanical or electrical device can take the place of an interpreter for translating from one existing language to another.

HOWEVER, it is possible to translate automatically sounds of existing languages into other sounds which are equivalent to a new language. Similar apparatus may then be used to translate these new sounds back to the original language from which they were derived.

The most obvious use for a device capable of performing this feat would be in a communication system for rendering ordinary speech unintelligible during transmission, and then translating it back to its normal form at the receiving end. This is, in fact, the basis of most secrecy systems, but, alone, it is not sufficient for complete secrecy since it would only be necessary for the eavesdropper to learn the new language in order to obtain the message.

However, it is of interest to consider one of the simpler methods of making

artificial languages since it illustrates in a striking manner the process of modulation or frequency conversion which is so essential to radio and carrier telephone communication. This method is called "inverted speech," since for every sound vibration a new one is produced whose frequency is equal to some arbitrary constant frequency minus the original frequency.

Such an effect is daily obtained in every radio broadcasting transmitter, but in that case the band of transmitted frequencies corresponding to speech is so far above the audible range that it is unintelligible for that reason alone. But if the constant or inversion frequency is decreased to a point below the upper edge of the voice band, the resulting waves are all audible frequencies. They are, however, differently arranged from those in the original speech, and to the ear they seem to have no relation to the original. The present apparatus, built by Bell Telephone Laboratories for demonstration purposes, employs an inversion fre-

quency of 3000 cycles and utilizes only the speech frequencies below this.

As a result of such an inverting process, new audible frequencies are produced corresponding to each of the original speech frequencies, and located just as far below 3000 cycles as the original frequencies were above zero. Using a normal speech range of from 100 to 2900 cycles per second and an inversion frequency of 8000 cycles, the resulting inverted speech also occupies the band from 100 to 2900 cycles but in the reverse order.

THE relation between normal and inverted speech bands is shown in Figure 1 in which the octaves above and below middle C are given for reference to musical pitch. The effect may be compared to that of a lens in forming a real image of an object: the top is made to appear at the lower part of the field and the bottom at the upper part. A pure tone having the pitch of middle C on the piano scale, which has a frequency of 256



INVERTING AND RE-CONVERTING

Figure 2: S. P. Grace is shown holding a telephone near a phonograph which is playing out inverted speech sounds. The portable set once more inverts the sounds and they come out of the loudspeaker in unscrambled condition, just as they were originally spoken in plain English

cycles per second, becomes 3000 minus 256, or 2744 cycles. Consequently the voice of a person talking in a low pitch comes out of the inverting apparatus as a high pitched squeak, with a low grunt now and then due to the overtones in the original speech wave.

ON listening to inverted speech for the first time it is impossible to understand a single word, although it is apparent that it is some form of speech on account of the characteristic inflections and marks of emphasis. One may, however, learn to interpret it by listening to known words as reproduced by the inverting apparatus. For instance "telephone" sounds very much like "playafeen" and "Illinois" becomes "Oyanail."

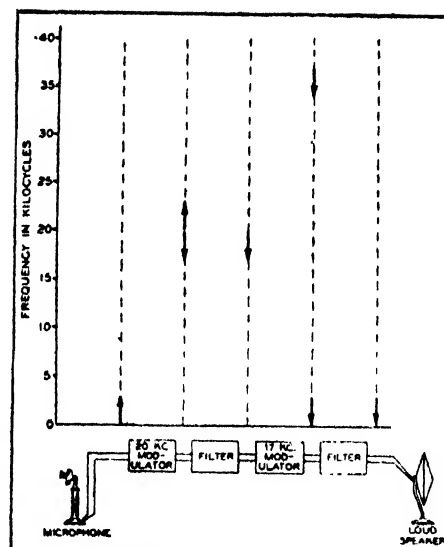
Then it is possible to learn to speak the inverted language by imitating the sounds coming from the inverting apparatus. However, this is not likely to be entirely successful since the process of inversion destroys the harmonic relation between the original speech frequencies. For example, if middle C and its second harmonic, upper C, are inverted, the resultant frequencies are 2744 and 2488 cycles, which are not harmonics and therefore could not be produced simultaneously by the human voice.

Nevertheless, it is possible to imitate some of the inverted sounds sufficiently well to produce intelligible speech when reinverted. Since the intelligibility of reinverted speech depends only on the fidelity with which the inverted sounds are imitated, very good quality may be obtained if they are recorded on a phonograph

for reinverting the recorded speech. These have been used frequently in demonstrations given in connection with lectures by Mr. S. P. Grace on "Recent Inventions of Bell Telephone Laboratories" before numerous gatherings of telephone engineers.

In the demonstrations the records are played on an ordinary phonograph to show how little resemblance the sounds bear to normal speech. Then some of the inverted speech sounds coming from the phonograph are picked up with a telephone transmitter and reinverted by the portable set shown in Figure 2. As a result the reinverted or normal speech comes from a loud speaker on the other side of the stage. The unintelligible sounds coming from the phonograph may still be heard, but only faintly, since they are largely masked by the greater volume of normal speech. To show that the reinverted speech actually comes from the peculiar sounds given off by the phonograph, the telephone transmitter is removed, whereupon the translated speech dies out.

IN the actual apparatus, two modulating steps are used which give the same overall result that would be obtained from a single modulation with a carrier frequency of 3000 cycles. This is necessary because it is difficult and sometimes impossible to remove some of the distorting current waves which are unavoidably produced by ordinary modulators when the desired output frequencies occur in or near the original speech band. But by first modulating the voice frequencies with a high-frequency carrier (20 kilocycles) and then



THEORY OF THE PROCESS

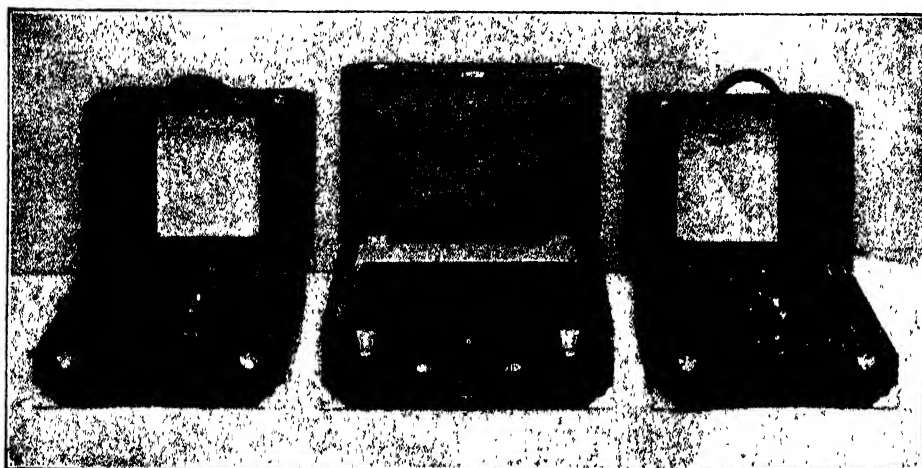
Figure 3: The arrows represent frequency bands produced by the apparatus shown

the heavy vertical arrows represent frequency bands produced by the apparatus. Following the diagram from left to right, the initial band of frequencies coming from the microphone modulates a 20 kilocycle carrier frequency and produces bands of frequencies above and below 20 kilocycles.

After the upper band is removed by a filter, the lower one is modulated by a 17 kilocycle carrier. This gives one high and one low frequency band of which only the lower one is retained. This completes the inverting process, for the resultant band then occupies the same frequency range as the original voice band, but in the inverse order. The steps necessary in reinverting the inverted band to normal speech would be represented by the same diagram with each arrow reversed in direction.

IN Figure 4 is shown a detailed view of the reinverting set, which consists simply of laboratory apparatus built into portable form. The center box contains the two filters for separating the frequency bands, while each of the other two boxes contains a high-frequency vacuum-tube oscillator and modulator. Particular care is necessary to keep the first modulator's carrier from being transmitted to the second, since this would cause a constant tone of 8000 cycles, which would be quite objectionable.

Although the apparatus and methods described above are not of commercial value in themselves, they illustrate some of the important principles used in multiplex carrier telephone systems and in radio broadcasting. One of the most remarkable features brought out by such a demonstration is that the original speech waves can be transmitted through all the apparatus necessary for inverting it and then reinverting it, and still come out so nearly like the original speech.



THE INVERTING SET BUILT IN PORTABLE FORM

Figure 4: The box in the center contains the two filters for separating the frequency bands. Each of the other boxes contains a high-frequency vacuum-tube oscillator and a modulator

record and then reproduced from it.

Records of inverted speech were first made about two years ago by Mr. J. W. Horton to illustrate the use of high-frequency carrier currents in multiplex telephone communication. About a year later a number of high quality records were made with improved inverting apparatus, and a portable outfit built

modulating the lower band of frequencies so produced by another carrier 8000 cycles lower (17 kilocycles), the distorting components are so widely separated that they may easily be removed by means of devices called filters.

The inverting process may be followed by reference to Figure 3 in which



THE DJENANG AND THE GROUP OF KUBU SAVAGES

The second man from the left is the chief and is the most intelligent—or the least unintelligent—of the tribe. Others of the group are mentioned by the author. To win the confidence of these timid people demands no little deliberation and patience.

The Kubu Forestmen of Sumatra

An Expedition to One of the Most Primitive Peoples on Earth, Who Dwell in the Primeval Forests

By Dr. TASSILO ADAM

Late Ethnographer to the Dutch-Indian Government



KUBU WOMEN

As with all primitive people, a woman of thirty is old in everything but actual years.

DURING my sojourn of 20 years as a planter in northern Sumatra I had frequently heard of the remarkable nomadic people who were said to live in the virgin woods of the southeastern part of that large island, and when I came to the mountain districts of the south, to the highlands of Palembang and Bengkulen, I heard still more of the people, who "ran away like timid deer or climbed into the trees like monkeys" on seeing a white man.

Through my exhaustive studies of the Battak people in northern Sumatra I had learned much of the customs and habits of primitive people, and my most ardent desire was therefore to get acquainted with those mysterious forest dwellers and to ascertain which were really true of all the doubtful tales.

What was my joy when I was commissioned by the Dutch-Indian Government to make an expedition of exploration through the southeast of Sumatra, in order to make photographs and prepare descriptions of these tribes.

Though several essays on this people had already been published, none of

the authors had to my knowledge been in the enormous virgin forests of the present residency of Djambi, where those tribes of the Kubus were supposed to live who had never or seldom met even with Malays, and Europeans absolutely never.

After staying a few weeks in Muara Bungo, a small place and the residence of a Government official, situated some days travel up the Batang Hari river, I at last receive a report from the messengers sent out, that some of the Kubus had been found in the primeval forest at a distance of about half a day's march.

ON the advice of the *demang* of Muara Bungo—the highest native official—I sent ahead some of his people led by the *djenang*, who is the only Malay who knows how to deal with the Kubus and who to a certain degree has their confidence, with presents consisting of rice, fruits, clothes, knives and spear-heads, in order to inspire the timid little people with confidence, so that they would not run away on seeing me.

The next day at 5 o'clock in the morning, I started with the *demang*,



ONE OF THE NATIVE HUTS

A few upright sticks are stuck into the ground and a meager "roofing" of palm leaves is depended upon to shed the rain. This is the whole house of a Kubu. It can be constructed in an hour

about ten bearers and the inevitable *djenang*. After a march of about five hours we reached a place in the midst of the tall virgin forest, where shrubs and undergrowth had shortly before been cut away, and where in some huts the long-sought Kubus were found quietly sitting.

What a strange sensation to find oneself with such people for the first time in the middle of the mighty primeval forest! Even for me, who as a planter was accustomed to the natives and had often passed the night among the Battaks, at that time very primitive, it was a grave moment. At first perhaps the same thing happened to me that happened to these people: they saw for the first time a white man, and I saw for the first time a pygmy people in a state in which I had never seen one before. Nobody spoke a word . . . utter silence. . . .

I ORDERED my bearers to lie down beyond view of the Kubus, only the *djenang* and the *demang* remaining with me. After having made myself comfortable with the box containing my photographic apparatus as a seat, I took a hearty draught from my camp-bottle and ate leisurely some bananas, to make it gradually clear to the people in this manner that they had no cause to be afraid of me. Of weapons I never carried any on my excursions, because it is my conviction that it is easier to gain the confidence of the people if one comes to them without a gun or revolver.

The close, damp air of the tropical forest, the sun standing vertically overhead, the horrible smell of the remains of beasts eaten by the Kubus, which they have thrown about, and the abominable scent exhaled by the Kubus

themselves—all these put my otherwise useful and loyal companion, the *demang*, in a humor which was anything but congenial. Also these wild people were not to his taste, and he could not understand why I took an interest in them and could endure staying here quietly for such a long time.

FOR a planter who had been obliged for 20 years to deal with Chinese coolies, even such a situation was, however, still far from unbearable, while the little crew who were sitting in front of me engaged my attention much too closely for me to heed the grievances of this official.

The Kubus continued to squat in front of me. Only the children disen-

gaged themselves after a time from their mothers, who may have been too afraid at first to approach, and crept from one adult to the other. The entire little tribe mustered only 14 heads: three men, four women and seven children. My first impression of them might be called strange but not bad.

I was struck most by the fact that all, especially the children, looked well nourished, but I was disappointed when the *djenang* said to me, "This is only so today, for they have eaten at once all the rice and the fruits which I sent to them. Otherwise this is a very sequestered tribe, difficult to reach. Only rarely do they get rice and bananas, sometimes through me." He also explained to me that they did not understand at all how to cook anything, but ate everything in a raw state, or at most a little fried over, and without any spices, even without salt. The scraps of food which I saw lying about fully bore witness to his statement.

ON looking at these savages more closely I came to the conviction that I had before me one of the most primitive people of the earth—miserable, wholly neglected people, without culture.

I may have sat thus for half an hour in conversation with my own companions, when I thought the moment had arrived to start an exchange of words also with the strange tribesmen we had come to see. The *djenang* served as an interpreter, partly because I could not yet understand the dialect, and partly because they had more confidence in him. The second man from the left in the group photograph was the chief of the group and perhaps the only one from whom a reply could be expected. While I formulated some questions to be addressed to him, which, after some



HOLDING AN AFTERNOON "AT HOME"

The "beds" show in the background. The sides are open, not only to the elements but to the wild animals that roam through the virgin forest. Our own ancestors may once have lived like this



THE COMPLETE HOUSEHOLD FURNISHINGS

Two mats, three bamboo water "buckets," two baskets, some knives, a tinder box, a drinking cup (cocoanut) and a bamboo box—this is the whole inventory of the rude Kubu establishment

reflection, he answered slowly and in monosyllables, I took a stroll around, as composedly and innocently as possible, in order to glimpse more closely all those present and to take away all fright and shyness.

SOON I was overcome by a feeling of pity, for the skin and hair of all of them were in a frightful state, most of their bodies were covered with a sort of fine scales like those of fish—an abominable, very bad-smelling and infectious disease—their hair was disheveled and full of unwelcome tenants. Even the *demang*, although himself a native and therefore certainly not as over-sensitive as a European, could not accompany me to the end on this inspection. He disappeared for a time and then returned as white as chalk, thoroughly cursing "this disgusting visit."

With the exception of the chief, the men and women did not impress me as being very intelligent. The younger man near the center, with the scanty, full beard, looked outright idiotic; neither could he be induced to answer my questions. While I took the photographs the position of the hands was quite typical of most of them: involuntarily the finger nails are continually scratching the skin, which certainly itches in an urgent way.

The gait of these people is very elastic, quick, and agile, but their whole mode of life makes them terribly lazy. Only if driven by hunger will they go in search of food which consists chiefly of herbs and fruits; especially, however, of the meat of "everything that moveth." Whether it is generally true that they do not kill or eat snakes and crocodiles, I should like to see further substantiated, for there are tribes of

the Battaks who eat dogs and monkeys, whilst with others such a thing would be considered a disgrace.

The *djenang* spoke with the chief, the others only harkening to the conversation at first. Soon, however, this interest gave place to their general indifference, and most of them sat down again or lazily stretched themselves out.

From what has been said already it will be seen that any attention to bodily cleanliness is quite beyond them; the useful employment of water is absolutely unknown to them. "A Kubu does not bathe." This had already been told me before, and here I could find the confirmation of this assertion.

JUST as with the Battaks, we find here two quite sharply varying types: one of a rather good average height, slender, mostly thin, the head also long and narrow, the nose well shaped, thin, sometimes even hooked, the mouth not very broad, with thin lips. The other and more common type, is of a shorter, heavier build, with broad shoulders, thick set, short foreheads, coarse features, protruding cheekbones, thick noses with wide nostrils, large mouths, heavy lips. That many of these inhabitants of the forest show a nearly Mongolian admixture, there is no denying. Further, some are conspicuous by their upper body being proportionately longer than the extremities.

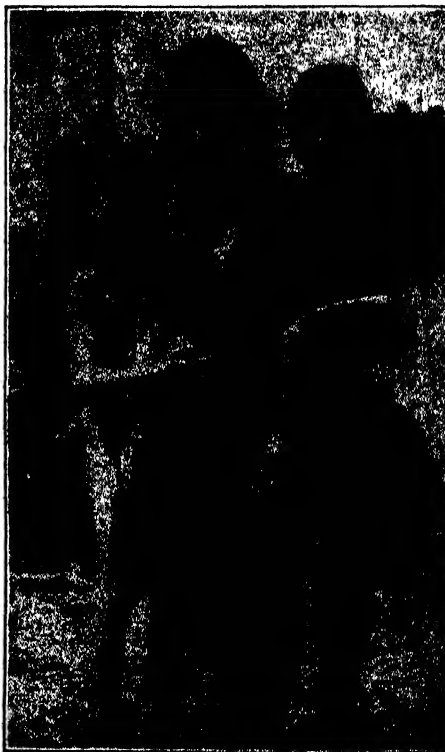
The growth of hair on the body is very scanty, but abundant on the head. It is of a dark brown-black color. At what time it starts to get gray could be fixed only by conjecture, as with these people even approximate statements of age are out of the question. If we find short hair with women and

particularly with men, then it is cropped with the ordinary bush-knife; or rather it is sawed off with it, which explains its irregularity. I could not find any really curled or deep black hair, as described by others, except that in some individual cases it is somewhat frizzled, and with women, wavy. With the men, whiskers are altogether absent. I met only with thin, stubby moustaches, and beards around the chin. The eyebrows are as a rule very thin, the same as the eyelashes.

The huts in which these strange creatures were sitting or lying can scarcely claim the name of dwelling, consisting only of freshly cut sticks stuck in the ground and bound together with rattan. On these were only just enough palm or tree leaves to keep off the heavy rain. At a height of about half a meter there were a few crosspieces of wood, some of them split, on which they lie. This is the whole house of a genuine Kubu.

THE Kubus are a wandering people. If the place where they have settled down does not afford sufficient food, they move on and erect their shelters on another spot at the shortest notice. These abodes do not offer the least protection against wild animals. Neither does a watchman guard them against attack at night. They sleep without a torch fire, left completely to their fate.

The whole of the household goods and also the complete hunting outfit are shown in the illustration above. More possessions than this are not owned by a Kubu family. We see here two plaited mats, not, plaited by the Kubus but



A TRANCE

One of the men goes into a hypnotic state and must be supported by the aid of others



TWO KUBUS

Obviously these are physically far from the "noble savage" ideal of the romantic writers

acquired through barter from Malays, a hanging mat of plaited split bamboo used partly as a sleeping mat (partly also to keep food), three long bamboos for water-containers, two baskets made of bark to be carried on the back, one round plaited basket, also Malay; also some short Malay knives, one big cropping-knife, a long throwing lance, a tinder-box with steel, stone and tinder, half a cocoa-nut shell for drinking, and a small Malay bamboo box.

HOW I would have liked to take away with me all these objects! But this was not to be, for it was all they had in the world. They had need of everything that I would have collected. However, I will quite honestly confess that in spite of all my cupidity, another factor was playing its part: not only my companions, but I also, felt a horror in touching the stuff.

From these tools it is to be deduced that the Kubus obtain fire by striking steel against stone, a custom which was certainly adopted by them from the Malays. Fire, however, does not play an important part with these nomads, for not every animal is roasted; to warm oneself by the fire is hardly necessary in Sumatra; and smoking is not known to a genuine Kubu.

The Battaks on the island of Sumatra had been cannibals up to 20 years previous to my visit. In 1902 an old priest cult man with whom I was very chummy, had told me with saliva dribbling down his chin, how excellent his grandmother had tasted to him

when he made a hash of her a short while previous. But no trace of such a habit is to be found with the Kubus, and it may be assumed with certainty that it had never been the case with them.

Whoever knows the most of life of these two peoples will not be surprised at this. The Kubus are the best natured people imaginable on earth. They know neither falsehood nor theft, they do not go in for robberies and live only in small groups, up to 40 heads at the utmost, and without direct contact with their other tribesmen.

Depending on statements of the chiefs and *djenangs* of the various groups which I have visited I estimate all the Kubus living in the primeval forests of Djambi (a territory nearly as large as Switzerland) at about 2500 souls.

THE dress with these primitive people consists only of the *tjawat*, bark beaten to a broad, soft material, which is drawn in lengths between the legs and wound around the loins.

As to their intellectual state in general, I can only say that my first impression from a visit to three different groups pointed decidedly in all three instances to the fact that here we had to do with people of an extremely low type, but after a lengthy conversation I always came to the conclusion that they are by no means unintelligent. Proof for this supposition is fully furnished by the Kubus who have been transplanted to Dutch settlements and who rapidly accommodate themselves to the mode of life forced upon them.

We have to do here with the best natured of creatures. According to our standards they are possessed of an absolutely inconceivable calmness and patience. The word time is totally

unknown to them. To questions concerning their age they are unable to give an answer, not even, as other primitive people say, "so and so many rice-crops," or as once an old Battak woman assured me, she was "seven smallpox-epidemics old."

From the two weapons which I found with them it is already clear that the Kubus are no warriors. Besides the simple throwing lance, about ten feet long, and the plain Malay cropping knife, which serves only for defence and for striking down wild animals, the Kubu has no weapon of defence or of offence. Bow and arrow are unknown on the whole island of Sumatra, and the blowpipe found with Battaks and the Sakeis in Malacca, who are so nearly related to the Kubus, has been looked for by me here in vain. Also the poisoning of the lances with *ipoh* or other vegetal or animal poison seems to be quite unknown to them.

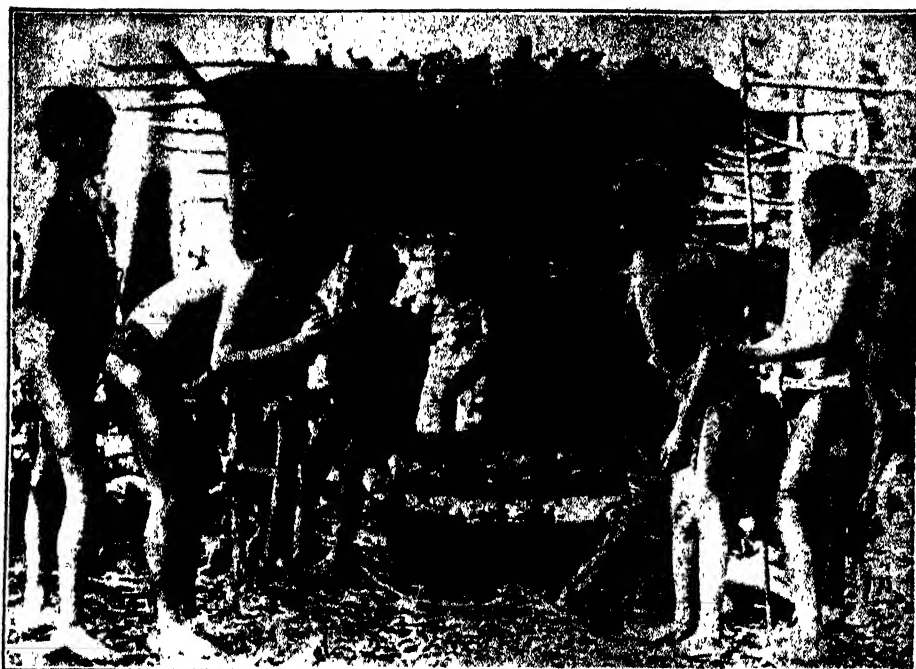
FROM this it will be seen that the Kubu is an extremely peace-loving being. He is very reticent towards the intruder, which however does not mean to say that he is a coward. If the latter were the case, then he would not rest at night on his open sleeping-place without a guard and without a torch. The tale which frequently crops up, that these people "clamber into trees like monkeys" on the approach of strange people, I decidedly doubt. In such a case would they not also have dwellings in the trees, or at least a sort of observation-post?

About the customs and usages at pregnancy, birth, marriage and death very little is to be said. Before and after the birth the husband provides the food for the wife. The birth happens without any ceremony, the husband assists his wife, and when the



A KUBU INTERIOR AND EXTERIOR

This may be taken as a Kubu version of home, sweet home. The padlocked box at the right belonged to the author. Two throwing lances, driven point down into the earth, show in the foreground



A FAMILY GATHERING

The mother and father are inside the house sitting on a divan. The children are engaged in a bit of interpretive dancing on the lawn in front of the residence. All primitive peoples love to dance

new child of the primitive forest is born, he is not bathed or washed, but only cleaned with leaves or with fine ground bark. After some hours, certainly the following day, the mother gets up again and looks for her food as usual.

About names and naming I learned almost nothing, which, however, need not be wondered at for the same limited group of people live their whole life together and do not at all come into contact with the world outside. Even among themselves they are very short of words. Perhaps because the names are difficult to remember, the *djenangs* give Malay titles to the men. Thus I heard them talk about Lurah, Temungung, Rio, and Adipati, at which they had to laugh themselves.

THE sort of relations that exist between parents and children, especially between the mother and her offspring, I was unable to find out. The whole group appeared to me as a single big family. Boys as well as girls go out into the forest themselves later and search for food.

When the time of maturity arrives, then there are no "long engagements," nor do they observe complicated marriage ceremonials. The young couple simply goes to its parents, declares to them that they now want to share together life's joys and sorrows, whereupon the girl is asked by her father whether this is really her wish. The affirmative "*tjah*" (yes) then concludes the whole formality. Monogamy is the general rule, but the man has the right to marry a second or several wives. There is therefore only marriage attachment out of love and affection. These primitive people merely

follow their natural instinct, and on the latter becoming extinct they separate again in most cases, and without formality. The children go with the mother or with the father, to whichever one they are the more attached. Not even this, however, is of much consequence, for the people do not go away, but all remain together.

IT is difficult from our European point of view to realize such extraordinarily strange conditions. Even for me much was strange, although I had lived fully 20 years among the Battaks. Everything, however, is so natural and simple, while the "man of culture" cannot imagine anything without cer-

tain laws, stipulations and formalities. When, then, we put questions to such primitive peoples, they are altogether unable to understand the purport of them, for such questions have no significance in their existence.

Life in the primeval forest has unspeakable hardships. The battle against everything that moves is bitterer than the outsider is able to imagine. A short stay with the Kubus, even on a rainless day, taught us enough of the plague of innumerable mosquitoes which are continually harassing these poor people; and many of them fall prey to hungry tigers or to the bite of snakes. A closer examination of their bodies is sufficient to show to what dangers these poor people are continuously exposed: apart from the skin disease already mentioned, many wounds, ulcers and scars show what they have to fear and to suffer through all their life. I was unable to get statements about malaria and dysentery, although I heard a child whine pitifully in a high fever.

WHETHER cholera had occurred with them I could not make out, but they seem to be scourged periodically by smallpox epidemics which rage terribly amongst them.

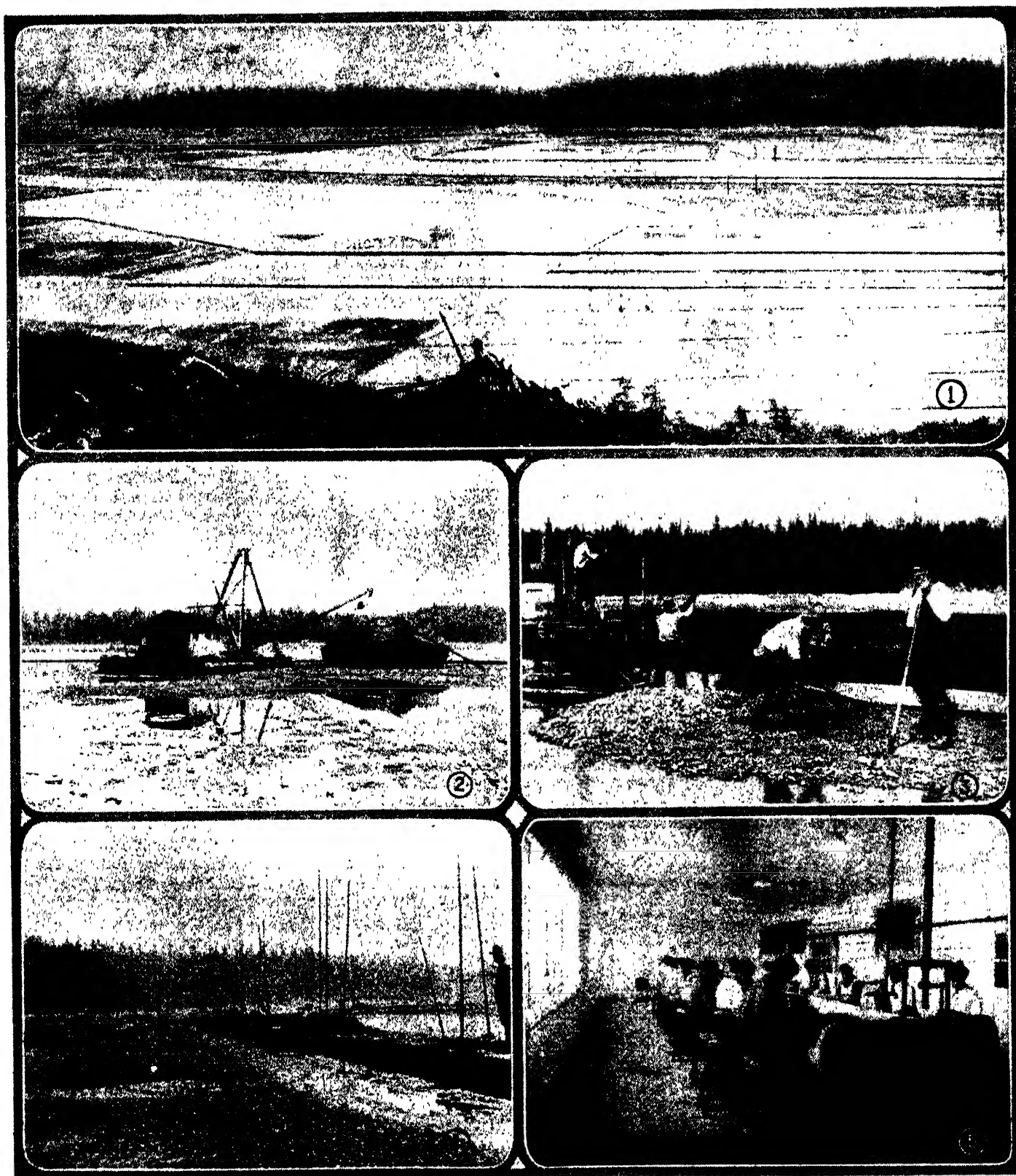
The chief of the tribe is asked, if somebody falls ill, to prepare curative herbs and roots. If no remedies are of avail, if help seems to be out of reach, the wretch is simply left to his fate. Without further care the whole tribe abandons him from fear of death. The Kubus know nothing about burying or burning the bodies of their dead, and places where somebody has died are shunned for a long time.

From all that has been said we may conclude with a sufficient amount of certainty, how low a stage of development these people have come to.



THE CHILDREN LOOK RATHER INTERESTING

The social unit is the family but the lines of relationship are somewhat difficult to draw. The children mainly belong to the family as a whole. This is a common stage in the evolution of the family



Farming the "Beefsteak" Oyster

THE photographs on this page illustrate features of the "farms" in Puget Sound, Washington, where an oyster, so large that it is called the "beefsteak" oyster, is being cultivated. These bivalves mature in three years as compared to the four years necessary for growth of Atlantic oysters. The seeds, smaller than a pin-head, are all imported from Japan where they are gathered after they attach themselves to clean shells strung on wires that are lowered into the water. Last year over 12,000,000 of these seeds were imported by the growers. In growing

them, large areas of very shallow water are used. Since the tide would leave this land bare 18 times a month, dikes are built to retain enough water to protect the oysters from frost and predatory birds. *Figure 1* shows the home of the "beefsteak" oyster. A bed in preparation is shown in *Figure 2* where gravel is being spread from a barge. In *Figure 3* a dike is being built, while *Figure 4* shows the method of seeding and harvesting with small scows. The crop of oysters is removed to a central opening house, *Figure 5*, where they are opened for shipment.

The Month In Medical Science

A Review and Commentary on Progress in the Medical and Surgical Field

By MORRIS FISHBEIN, M. D.

Editor of the Journal of the American Medical Association and of Hygiene

Determining Fatherhood

ONE of the most important medico-legal questions constantly disturbing the courts is the determination of parenthood in cases of importance, particularly where large amounts of property may be involved. The evidence assembled in various places in recent years concerns the use of the phenomenon of iso-agglutination; namely, the manner in which the fluid matter of the blood of one person reacts to the corpuscles of that of another. These investigations indicate that it is possible to say in some instances that a certain man could not have been the father of a certain child, although it is not possible to say definitely that a certain man is the father of a certain child.

One of the highest courts in Prussia has even refused to accept the blood test as supporting the first conclusion. The court based its decision on the fact that in 1926, 2000 children were examined and that there was one child in the 2000 about whom it could not be said positively that a certain man was not the father. The Medico-Legal Society of Berlin took action condemning this decision of the court. Many lower courts both in Germany and Austria have recognized the blood test as being of value in determining fatherhood. The Society did not believe that doubtfulness in one instance should serve to cast discredit on such evidence as might be definitely developed in other instances, pointing out that all evidence may be susceptible to error to this extent.

It seems likely that most of the courts of the world will be willing to accept the evidence afforded by the blood test when the reactions are definite, of course, taking this material in relationship to all of the other material that may be available.

Finger Prints by Wireless

THE finger print, foot print and even the nose print represents means of personal identification which are not susceptible of modification and which are perhaps the only means of personal identification that are certain. It is important to know therefore that the police of London have recently used a new system by which finger prints can be sent by means of wireless to all parts of the world. A person detained by them and be-

lieved to be wanted by Chicago police was identified through finger prints transmitted in this manner.

In a previous case, finger prints sent to New York enabled the detection of a counterfeiter who had escaped while on parole. In the new system of transmission the various whorls, circles and loops are described by index letters and figures, and can be reconstructed at the place of receipt in a few minutes.

The Centenary of Blood Pressure

ONE hundred years ago there first appeared the device invented by Léonard-Marie Poiseuille of Paris for measuring accurately the human blood pressure. This device is the mercury manometer familiar to every one who has had a life insurance examination. The device used today differs but little from that originally developed by the French investigator. It has been improved, of course, by modern manufacturing methods. Substitutes in the form of spring devices are used, but for extremely accurate measurements, the mercury column still is considered superior by many physicians.

Today the blood pressure determination is perhaps the most significant of all of the investigations made preliminary to ascertaining whether or not

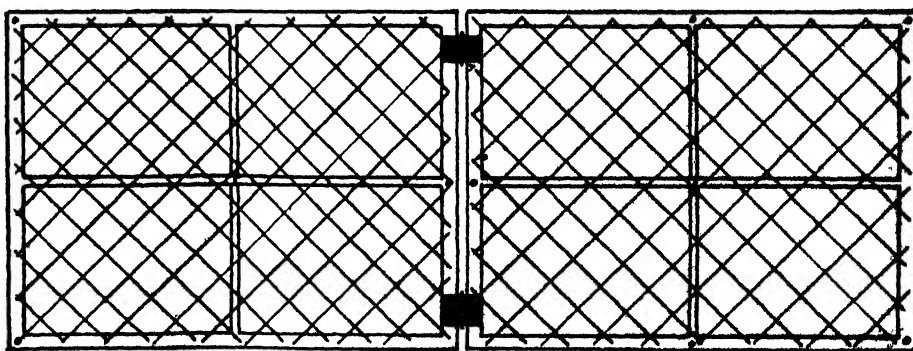
turbance of the kidneys. Of persons dying after 45 years of age, approximately one in three dies of one of the terminal complications of high blood pressure.

The exact cause of many of the cases of high blood pressure is not known. The pressure may be influenced by disturbances of the glands, by diseases of the heart, or of the kidneys, and by changes in the blood vessel walls. Investigators have set an approximate limit of 150 millimeters of pressure for a man 40 years of age as a sign of high blood pressure. In the vast majority of cases the condition comes on insidiously, being most frequently discovered during a routine examination, such as for insurance.

Men are more likely to be troubled with the condition than are women. Much has been said of the relationship of heredity to the disease, and the available evidence indicates strongly that high blood pressure is hereditary and familial.

Window for Transmitting Ultra-Violet Rays

SINCE it has become well established that ultra-violet rays have a beneficial influence in the prevention of rickets and probably on health gen-



WINDOW FOR TRANSMITTING ULTRA-VIOLET RAYS

Windows such as this one can be made and used in the home. It consists merely of a light wooden, hinged frame and a layer of Cellophane sandwiched in between layers of chicken wire.

an applicant is a fit subject for insurance at the ordinary rates. The human blood pressure should be approximately 120 at 20 years of age, and it is customary to add 2 millimeters for every five years up to the age of 60 years, so that the average at 60 is 135. During 1924, one in five of the persons who died in the United States died as a result of one of the complications of high blood pressure, heart failure, hemorrhage into the brain, or dis-

erally, special types of window glass have been created to permit the transmission of these rays from the sun.

Dr. A. H. Pfund has described a method of preparing a window for use particularly for a sleeping porch or bedroom, reasonable in price and generally useful. A light wooden frame is prepared and covered with coarse chicken wire. The substance called Cellophane, which permits the transmission of the ultra-violet rays, is then laid over the

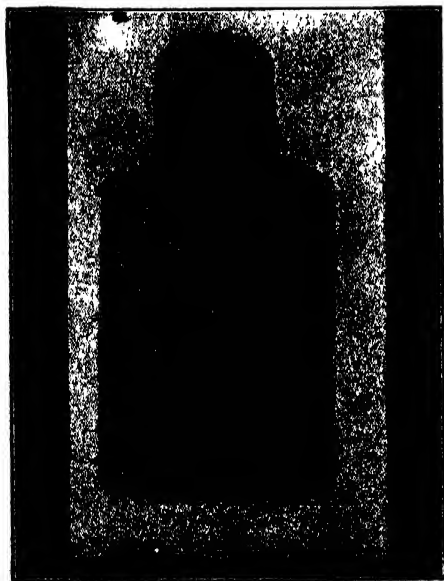
chicken wire and one layer of chicken wire placed over it. Screws serve to hold the "sandwich" together. Such a window permits full transmission of the ultra-violet rays and loses but little in its transmission powers after having been exposed to sunlight for a year. The materials are cheap and the entire window can be prepared at a cost well under a dollar.

Eye Injuries by Air Guns

INJURIES to the eyes by the indiscriminate use of air guns and sling shots are so frequent as to have made necessary a special report by Doctors F. H. Rodin and Albert B. McKee. In three cases described by them, BB shots and a staple thrown by a sling shot passed into the eyes, resulting in serious inflammations and requiring surgical removal. In many instances, if the foreign body is not infected, it may lie in the eye for weeks and become encapsulated so that no action is taken until sight is suddenly lost due to the formation of a scar or to interference by the foreign body with vision. In one case, the BB shot was spontaneously forced out of the eye 16 days after it entered; in another case it lay in the eye for two months before it was necessary to take any action. Modern methods, involving the use of the X ray, permit exact localization of the foreign body and make its removal much simpler.

A Splint for a Broken Thumb

FRACTURES and dislocations of the thumb are not infrequent, particularly as they occur in association with sporting events, such as base-



STRUCTURE OF SPLINT

Four pieces of tongue depressors, cut and shaped as shown, serve as the rigid support

ball and boxing. It is frequently necessary to hold the thumb in a correct position for long periods of time in order to secure proper healing. Plaster of Paris is useful for the purpose but

requires time to put on and is bulky and uncomfortable for the patient. Dr. Charles W. Lester has invented a combination of tongue depressors and adhesive plaster which makes an exceedingly useful splint, easily removable, comfortable to wear and satisfactory for the purpose.

This splint is made by pasting on the adhesive plaster four strips of tongue depressors, varying in length so as to control the short and long sides of the thumb. Plaster is cut so that it fits easily without wrinkling when the device is fitted over the thumb. It is held in place by three narrow strips of adhesive.

The Dirty Shirt

THE sanitarians have found that repeated washing with soap and water and drying in the sun constitute perhaps the best method that we have for eliminating infection on a large scale.

Recently, Gladys P. Winegar of the University of Nebraska, determined to find out how many bacteria accumulated on underwear worn for a long period without washing. After the underwear was worn one day, the average count of bacteria per square inch was 400,000. If the shirt was worn six days consecutively without washing, the number increased to nearly 10,000,000 bacteria per square inch. When the shirt was laundered and then dried, the number of bacteria was reduced to 1,000 per square inch or less. The washing alone was effective, but much better results were accomplished by drying thoroughly and particularly by drying in the sun.

The germs found were those usually found on the skin, particularly the pus-forming organisms that are associated with pimples and similar skin infections. More and more underwear is being eliminated from the modern feminine costume and the one-piece dress is worn with but a minimum of clothing beneath. This top dress is not washed or cleaned daily; in fact, not even weekly or monthly. Yet for the most part it is the garment which comes into constant contact with the skin of the shoulders and the upper portion of the chest. The increasing amount of minor infections of the skin of these regions may be associated with this constant contact of heavily germ laden wearing apparel with the skin in the regions concerned.

More Reducing Creams

THE craze for slender beauty is apparently still sufficient to encourage promoters in continuing to issue inefficient combinations of ordinary substances with exaggerated claims as to their ability to remove superfluous flesh. One of the concoctions most recently promoted under the name of "Nature's Way Reducing

Cream" consisted simply of a mineral oil, wax, Epsom salts, baking soda and alum. The woman with abnormal breasts, large hips, or heavy thighs was urged to reduce these portions of her anatomy by rubbing on the mixture. The promoters were enabled to get it on sale even in large department stores and many women paid as much



SPLINT IN PLACE

The wooden strips shown below are held in place on the thumb by adhesive plaster

as 15 dollars for a few ounces of this concoction. It is obviously preposterous that the rubbing in of such a mixture would reduce any portion of the body.

There is one sure way to take off fat safely, and that is to reduce the diet and to take enough exercise to use up the calories that are taken in.

Vitamins in Clams and Oysters

PHYSICIANS and dieticians are constantly searching for foods containing vitamins, since these substances are so important for life and since the average human being likes a varied dietary. It is now shown that oysters and clams contain not only protein and sugar, but are comparatively rich in their vitamin content. They vary, however, in this regard. The oysters are rich in vitamin B, but neither the hard nor soft clams contain it in appreciable quantities. Vitamin A is also found in oysters in larger concentration than in clams. The clams, on the other hand, contain more vitamin D than do the oysters, but the oysters contain more vitamin C. Both the oyster and the clam are valuable as parts of a well balanced diet and furnish plenty of justification for adding shellfish, even were it not for the fact that most people like them.

The fact that oil of the cod's liver is the richest of all food substances in vitamin D would seem to be a sufficient suggestion that similar properties can be expected in other marine animals.



FULL SPEED AHEAD IN FORMATION

Destroyers maneuvering at full speed. The wake of the leading destroyer may be seen in the right foreground. These ships are capable of high speed, yet are sea-worthy enough to remain with the fleet at sea. Each of these carries a number of torpedoes and has appreciable gun-power

Naval Adequacy—II

*Ships in a Wide Variety of Types and Classes Are Needed
By a Navy to Perform Numerous Duties
During War or Peace-time*

By CAPTAIN N. H. GOSS, U.S.N.

THE second element of sea power to be considered at length is the subject of ships.

The discussion of naval bases naturally came first because the types of vessels, the classes of each type, and the relative numbers of each necessary to form an effective navy, depend so largely, as we have seen, upon naval bases.

"Fleet" is an inclusive term because it includes ships of many different general characteristics, known under the classification of "types," which are necessary to meet the various needs for sea or air-borne craft. But, within the limits of types, there are also some differences in size, speed, and gun-power which are commonly referred to by the term "classes." Naval architecture being, like most other things, in process of gradual evolution, progressive improvements are naturally embodied in succeeding classes, so that the better examples of each type are nominally found in the later classes.

While natural evolution, as noted, brings about successive improvements in the class or type of naval craft, invention and discovery also introduce new types as new weapons or new

means of defense are developed. As an example of this, a new type, adapted for steam propulsion, succeeded the sailing vessels of the sailing era; the monitor type, mounting its guns in revolving turrets so that they were useful in all directions instead of simply as one broadside, was evolved during the Civil War. Later the small, high-speed type was developed to carry the newly-invented, self-propelled torpedo; a somewhat larger, faster type, called the torpedo-boat destroyer, was developed to combat this; and so on.

OTHER examples of development were the introduction of the submarine type; the utilization of aircraft for naval purposes, including ships to carry aircraft; and, in our navy particularly, repair ships and tenders that have been developed to make our vessels more self-supporting while away from the navy yards and to offset, in some degree, our lack of well located naval bases.

Thus a modern fleet consists of a multiplicity of types, such as capital ships—comprising battle-ships and battle cruisers—cruisers, destroyers, submarines, airplane carriers, tenders,

repair ships, hospital ships, mine planters, and various auxiliary types such as passenger liners for use as transports, oil tankers, cargo ships, tugs, and mine sweepers. A fleet is not effective or efficient in a modern sense unless it comprises all these types, because each has its special purpose which no other type of vessel can fulfill.

The backbone of a fleet is the capital ship, not only because it has the greatest fighting power of any type of vessel, but also because it alone has effective defensive or resisting strength. It carries guns of the largest size in its battery. This type also is the only one large enough to permit the great amount of sub-division into compartments necessary for under-water protection; to carry side and deck armor of sufficient thickness to withstand the penetrating effect of modern shell and the explosive effect of the modern bomb; and, in addition, to have space to carry the machinery necessary to propel the ship at sufficiently high speeds.

The modern capital ship has all these qualities. It carries turret guns of heaviest caliber capable of firing projectiles that can penetrate armor at

ranges in excess of 20,000 yards—far beyond the horizon and out-of sight of a man on deck. It carries in its magazines enough ammunition for these turrets to keep up an engagement lasting for hours at a time. Its underwater, side, and deck protection enable it to lie in the line of battle throughout an engagement and resist all forms of attack. This latter point is extremely important—and particularly so for us whose ships must operate for long periods and at long distances away from bases. The capital ship is the only type large enough to be given sufficient protection to withstand the attacks of modern guns, air bombs, mines, and torpedoes, and yet remain in the line of battle and continue to fire its own guns.

No other type has the size to afford this protection or to undergo the compromise of space necessary in any man-of-war, since no ship can disregard any of these factors and still be efficient. If too much space is given to protection, the result will be low speed; if too much attention is given to gun-power, the ship will lack protection; and if too much consideration is given to speed, it will certainly lack protection as well as gun-power, unless of super-size.

ALL naval vessels must necessarily represent some compromise, but the capital ship is the only one that is large enough to allot sufficient tonnage to each of these necessary factors. As mines, torpedoes, and aircraft became more effective, capital ships had to be made larger to accommodate the necessary defensive features. An example of too much compromise in favor of one of the desired qualities was shown in the disaster to the British battle cruisers at Jutland, where protection had been sacrificed to gain speed with the result that their magazines lacked the necessary protection. A battle-ship of a late type which was better protected, successfully resisted a concentrated fire of the heaviest guns. This was the *Warspite* of the "Queen Elizabeth" class.

Battle-ships on each side successfully withstood torpedo hits at Jutland without slowing down or leaving the battle line. Newer capital ships, however, have much more efficient under-water protection while the older ones have had torpedo bulges fitted to increase their under-water resisting power. Furthermore, all capital ships now have effective deck protection against bombs.

Capital ships are divided into two types: battle-ships and battle cruisers. While each is of the largest size, the former type is fitted with maximum protection and a greater number of heavy guns. Consequently it is somewhat the slower. In order to embody at least under-water protection and the highest speed, the battle cruiser type, which should normally be the larger of

the two, has somewhat less gun-power and slightly less armor protection. In the World War, the German battle cruisers fared better than the British, because they had better protection for their magazines and a more complex watertight subdivision. The subdivision was so good, in fact, that one German battle cruiser reached port after the Jutland battle with more than 7000 tons of water aboard.

AIRCRAFT carriers are one of the modern types of vessel. The fact that all kinds of aircraft have a limited operating radius and are dependent upon frequent return to some base, necessitated the development of a type of ship that would house aircraft crews and furnish fuel and supplies. They also carry land planes as well, since seaplanes are slower than the land type, harder to maneuver and, even though catapulted, cannot always land safely or conveniently upon water.

The modern plane carrier is equipped with what amounts to a fair sized landing field. All carriers are inherently vulnerable above water inasmuch as shell fire or even light air bombs would damage their landing deck; but it is desirable, and at the same time possible, for them to have adequate under-water protection against mines, torpedoes, and the mining effect of bombs dropped alongside. These plane carriers should have as high speed as is practicable since they must accompany the fleet at sea. It is desirable, to facilitate attack, defense, or raiding operations, that they have very high speed.

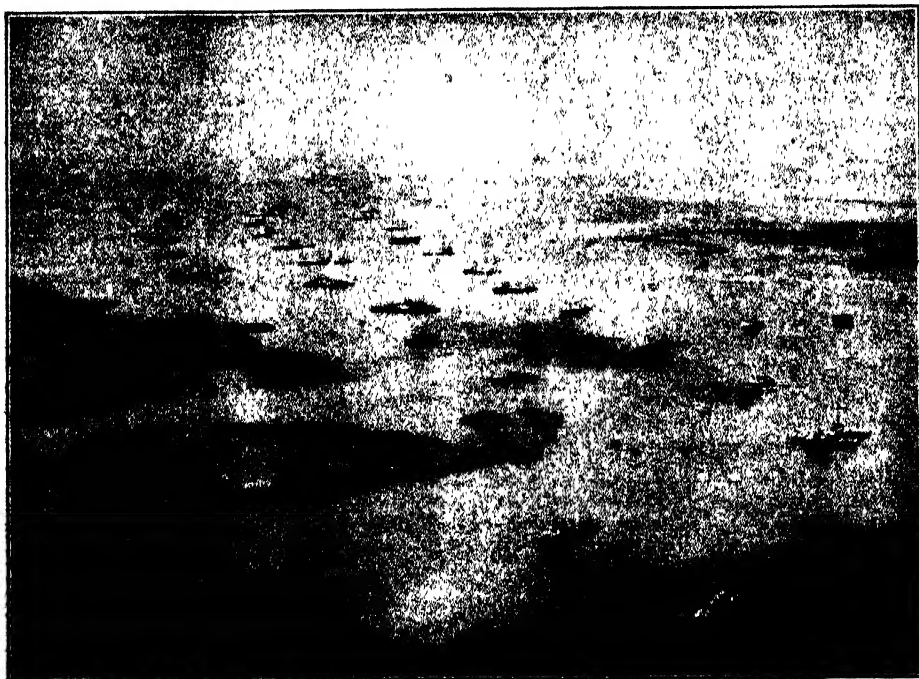
Modern plane carriers carry large numbers of planes—easily more than 50 and some as many as 75—and are

self-contained and quite complete floating airports. Not only is the landing deck a flying field, but each carrier contains repair and overhaul shops, quarters for personnel, fuel and bombs for the planes, and all the necessary hoisting apparatus for seaplanes as well as land machines. If the carrier be large, such as are those of Japan and our new ones, it is feasible for them to have high sea speed and very complete under-water protection.

The present cruiser type is the modern development of the frigate of Nelson's day. Those who have read naval history will remember Nelson's constant cry for more frigates to enable him to search for the enemy fleet and keep up his communications. While radio has eliminated the despatch-bearing requirement of the former day, cruisers are still just as indispensable for communication duties, since they carry the longest range radio and are otherwise adapted to the performance of modern observation duties. In a fleet, each type naturally has its own particular duties, but those falling to cruisers are varied as well.

WHEN the fleet is cruising, cruisers are necessary to form the main units of the screen—either an offensive screen operating at long distances, or the protective screen operating at moderate distances. Since protection is necessary in more than one direction, considerable numbers of cruisers are required for this purpose.

Cruisers are necessary also for fleet communication duties, it being necessary for them to serve as both radio and visual-linking vessels to enable the commander-in-chief to maintain contact with the various units comprising



GUANTANAMO BAY, CUBA

All types of modern ships of war are represented in this United States Navy group at anchor. Here may be seen capital ships, cruisers, destroyers, submarines, tenders, plane carriers, et cetera

the fleet. When the fleet is deployed in battle formation, cruisers have again a special rôle to play: that of supporting the attacks of our own destroyers, while at the same time protecting the battle line from the attacks of enemy destroyers. Here, again, numerous cruisers are needed because, if the development of the action involves large changes or reversals of course, there is not time for the light forces ahead to change their position and gain their new stations; therefore there must be a force also operating along the normal rear of the formation.

An example of modern cruiser efficiency was the work, at Jutland, of the Second Light Cruiser Squadron under Beatty, in developing the first contact and, later, in discovering and reporting the presence of the German High Seas Fleet. An example of the lack of effective modern cruisers was the failure of the Grand Fleet under Jellicoe to make timely contact with Beatty after Jellicoe's thin screen of old cruisers had been thrown away from his front by his successive changes of course to the right.

CRUISERS are the normal counter against destroyer attacks, for, if enemy destroyers are permitted to arrive within torpedo range of the battle fleet, the destroyers' torpedoes will cause the heavy ships to maneuver at least and this, in turn, breaks up their fire, the resultant advantage going to the enemy side. On the other hand, if cruisers in sufficient strength are present, enemy destroyers are attacked by these while they are still beyond torpedo range. Such modern cruisers have not only speed approaching that of a destroyer, but also have sea-keeping qualities that, in normal seas, enable them to maintain their speed when destroyers are obliged to slow down.

Light cruisers have other duties as well. While large enough to keep the seas in all weather, they have considerable gun-power and long cruising radius; hence they are well adapted to convoy duty. Since a nation that is deficient in naval bases must employ many of these convoys, fuel ships, and supply ships over long distances, considerable numbers of these cruisers are necessary to safeguard them from enemy attacks enroute.

By their high speed, long operating radius, and good sea-keeping qualities, cruisers are also well adapted to reconnoitering and raiding duties, and are especially necessary if battle cruisers are not available for this work.

To attain the high speed necessary, cruisers have to be fairly large and, since so much space must be devoted to machinery, they are correspondingly lacking in protection and are very vulnerable, although large and conspicuous targets. Here, again, the numbers of this type are predetermined somewhat by the number and kind of naval bases owned; and the nation lacking these needs cruisers in numbers to offset inevitable damages and losses.

The first torpedoes were carried on a spar attached to a picket launch; as such they were successfully employed in the Civil War, a notable example being the sinking of the Confederate

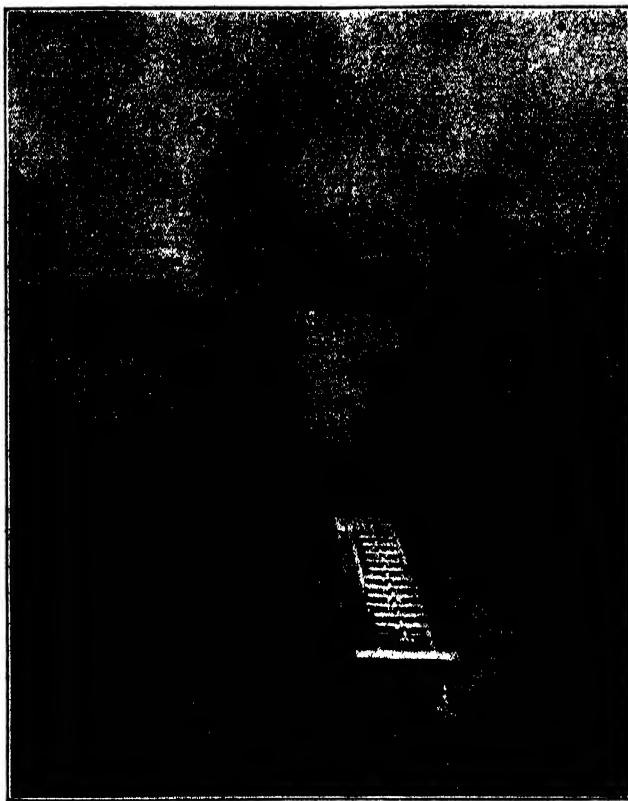
tremely vulnerable. Since they are so vulnerable that an attack *en masse* is necessary, they have to be very numerous in order to be effective. They are a potent weapon, however, because the great numbers of torpedoes that may be loosed in a concentrated destroyer attack is a constant threat. The German destroyers, for example, caused Jellicoe to turn away frequently at Jutland and enabled the German fleet to escape from his overwhelming gun-fire.

The late war developed another highly important use for the destroyer as an anti-submarine weapon. Being large enough to keep the sea, particularly with slowly moving convoys, and large enough to carry a considerable number of depth charges, (our destroyers in the European war zone during the latter part of the war, carried as high as 50), the destroyer has proved to be the most effective weapon against the submarine yet devised. It is also useful in rescuing crews of disabled vessels or troops from transports, more than 800 survivors having been rescued at numerous times by single destroyers.

IN modern war, destroyers are necessary to serve as an anti-submarine screen with the heavy ships of the battle fleet, to attack and drive enemy submarines below the surface. Since destroyers are very uncomfortable at sea, carry only a limited food supply, and have only limited high-speed radius, they are absolutely dependent on harbors that are at least sheltered and in which they may re-fuel, take on food supplies, and where their crews may have recreation.

War experience revealed the necessity of a somewhat larger vessel to work with destroyers, since a destroyer alone is not large enough to carry the necessary staff or signaling and radio equipment, or steady enough to facilitate necessary observations for torpedo control. The "destroyer leader" type was developed to meet this need. This is a high-speed vessel around 2000 tons, carrying the same torpedo equipment as the ordinary destroyer and having somewhat greater gun-power.

Submarines are also, of course, a comparatively modern type. In fact, there are now really two types of this vessel. One of these, around a thousand tons or smaller, has limited surface speed but is suitable for defensive purposes off the coast or for operating from a base in an island possession. Submarines of this type have comparatively small crews, carry substantial torpedo equipment, and, for their size,



PASSING IN REVIEW

Air view of the fleet steaming out of Hampton Roads, Virginia, passing in review before the President of the United States

ram *Albemarle* by Flusser. As the automobile torpedo developed, small vessels of high speed for the day, called torpedo boats, were developed. This was the type in use during the Spanish-American War. Their small size, however, made them unsuitable for use at sea. The modern torpedo vessel is a development of the larger torpedo boat destroyers which were originally designed to combat these small torpedo vessels.

Modern destroyers are vessels having the highest speed, yet which are large enough to remain with the fleet at sea, and to be fairly seaworthy. They carry a considerable number of torpedoes—often as many as 12—and have appreciable gun-power. As they have even more machinery, comparatively, than cruisers, they are ex-

have excellent maneuvering ability.

The other type of submarine is a larger and more seaworthy vessel, having considerably higher surface speed and more gun-power, which is called the "fleet" submarine. This type is designed to accompany the fleet at sea and operate with it. Hence it is more self-sustaining than the smaller type. But, since all submarines have very low submerged speed; since the above-water hull of even a fleet submarine is not well adapted for cruising in anything like heavy seas; and further, since the larger type is desired to operate at considerable distances ahead of the fleet—hence is thrown out of position by material changes of course—even these vessels have to be in considerable numbers to be of great value in a practical sense.

WHILE submarines received a great deal of public attention during the World War, their use, and hence the attention they received, was so focused on attacks on merchant vessels that their potential value as a part of the combatant fleet was not greatly considered. Submarines actually possess one extremely important military characteristic that belongs to no other type of craft, for, practically speaking, they cannot be driven in or driven away; hence they are extremely valuable on reconnaissance or observation duty. Actually, while the public did not hear much about it, both the Allies and the Germans used them for this during the World War. They would be much more valuable, even, for uses of this nature away from restricted areas such as obtain off the German and British coasts.

It would be hard, in fact, to exagger-



A MODERN TENDER

Each destroyer squadron of 19 vessels is based on a tender which carries supplies and makes minor repairs. This enables destroyers to cruise with the fleet and remain away from home ports

ate the military value of the modern submarine. It can now operate at long distances from home and can remain at sea; it, alone, of all craft, is invisible; it is independent of gravity; and it possesses all the advantages in the game of hide and seek, for it can observe its enemies long before they have any chance to observe it, can quietly drop below the surface until the danger is past, and can then come up and go about its business.

Since, however, all submarines have low submerged speed and low surface speed in heavy weather—even the larger type—and, as all submarines are vulnerable, they are effective only in numbers. Due to the low relative

speed of submarines and to the fact that even the large ones are very uncomfortable, a country having abundant bases and harbors has an inherent advantage which a larger number of enemy submarines would find difficult to overcome.

Mine-laying vessels are very essential in modern warfare, since mines play an important rôle in the actual damage they inflict, in the hampering effect they have on fleets' movements, and in the constant threat they exercise in the shallow water off a port and in comparatively deep channels as well. Fortunately, small and fairly fast merchant vessels are readily adapted to mine-laying duty and a fleet, in time of peace, does not need many specially constructed vessels of this type, it being necessary to have only enough to provide a skeleton organization of trained personnel for this duty.

SINCE destroyers and submarines have not the stowage space to carry any considerable amount of stores and provisions and can carry only repair equipment of the most limited nature, the "tender" type has been developed to supply these needs. Tenders are really vessels of merchant-ship type equipped to carry the stores and fresh provisions which these small vessels require, and also considerable machine shop and repair equipment. A pontoon equipment makes possible the shifting of propellers without docking. This goes a long way toward solving the problem of maintaining these vessels while they are away from home yards.

Repair ships are also vessels of merchant type. They are equipped with small foundries, blacksmith shops, and machine shops for making minor repairs on other vessels away from navy



A PORTABLE SUBMARINE BASE

A submarine tender, like the U. S. S. Beaver illustrated here with a division of submarines, makes it possible for these vessels to operate away from a fixed shore base for long periods

yards. The value of this kind of equipment was clearly demonstrated during the World War when all our destroyers in the European war zone were based on such tenders. These vessels not only enable the destroyers and submarines to cruise with the fleet but effect a considerable money saving on repairs that are made in peace time, since

the target. In fact, navies are in no wise limited even to carriers or shore bases, for all sizeable vessels—all the combatant types, in fact, above destroyers in size—now carry airplanes. To enable ships to do this, our navy pioneered in the development of the catapult which is capable of launching a plane after a run of only about 60

modities. An extensive merchant marine is particularly necessary to a country without amply provided naval bases in its insular possessions or along its lines of communication. Even to sustain a fleet in an overseas expedition requires literally hundreds of vessels of merchant type. In an expedition involving troops, many fast vessels of the passenger liner type are required as troop transports. Obviously, as it would be too expensive to build and maintain such vessels for naval use only, a naval power is dependent on a merchant marine; and the country possessing a large and efficient fleet of this nature, has a tremendous advantage over one that lacks it.

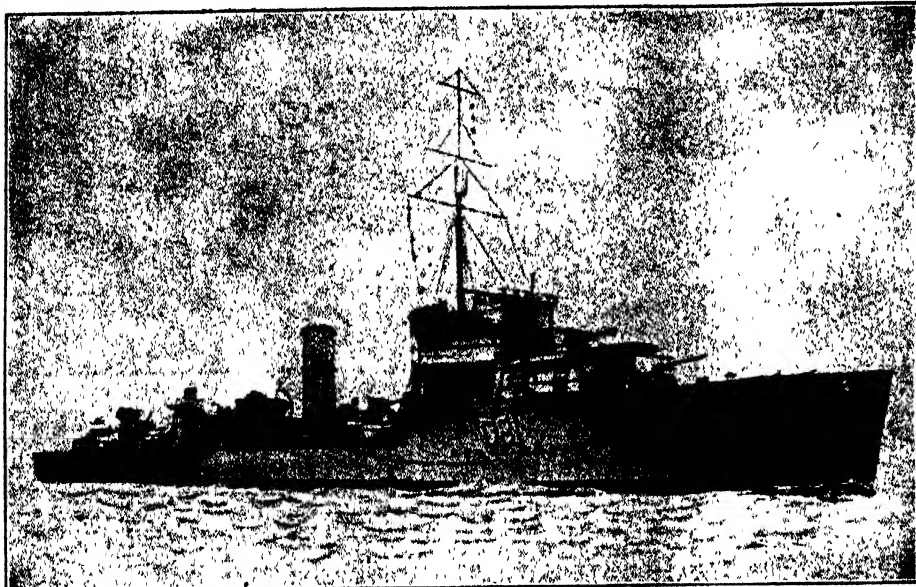
Thus our discussion of "naval strength in terms of ships," shows that a well-balanced, adequate navy consists of many types of craft, all of which have been developed as the result of experience. A fleet would not be complete nor could it exert its full strength with any of these types lacking. But two types that have continued in use are the capital ship and the cruiser. New weapons have brought changes in their characteristics but the type still persists because the same need continues for a fighting vessel that can take, as well as give, the heaviest blows, and for a reliable and swift vessel to maintain communications. The capital ship has had to be protected successively against under-water attack and air attack. Modern examples of such protection are: greater subdivision, bulges, and deck armor.

MODERN fleets are more complicated than ever before but that is all, for the basic elements remain. New devices and new methods are employed, but the fundamental principles remain the same. The arbiter of victory is still the heavy turret gun, the only weapon that can plant its projectile, now weighing over a ton and carrying hundreds of pounds of high explosives, into the vitals of a ship. It alone can penetrate any armor and protection yet devised. It can not only do this at distances far beyond the horizon, but can repeat it hundreds of times without replenishment of magazines or return of the ship to port.

Scouting and screening and communications are now extended by the airplane and by the radio and the submarine, but more, rather than less, cruisers are required to co-ordinate and support these modern measures, for the areas to be covered are now so extensive.

So we see how naval strength is dependent upon a multiplicity of types of ships all dependent on each other.

Captain Goss' third article, dealing with the subject of comparative naval strength, will be published in the November issue. Watch for it.



AN EXTREMELY IMPORTANT TYPE WE LACK

A British destroyer leader. These ships have great maneuverability and can accommodate the extensive signaling equipment necessary, and the commanding officer of a flotilla and his staff

all the work is done by enlisted men.

Aircraft are also properly incorporated in the general discussion of vessels. The principal naval powers and particularly the United States, it so happens, early recognized the great potential value of this type of craft; and naval officers were among the pioneer pilots trained by the Wrights and by Curtiss. Previous to this, one officer who became famous as a pilot—the late Commander Rogers—went aloft from our cruisers in man-lifting kites, the very earliest development of naval aviation. The United States Navy was naturally interested from the first in the development of the seaplane and, in fact, sponsored its development. As before noted, however, seaplanes of the larger, or flying boat, classes, while of long radius and of ample size for personnel requirements, are too unwieldy for many purposes; hence the navy is concerned also with the use and development of planes of the land type. Thus we find that modern aircraft carriers are designed and built to carry planes of all types except the very heaviest bombers, these being operated by navies from their air stations ashore.

PLANES, aside from these normal uses, are particularly necessary and valuable for many special naval purposes. In addition to bombs, they are employed to carry torpedoes that are to be dropped within torpedo range of

feet. This enables cruisers and capital ships to carry their own planes for a highly important modern use, namely, to observe or, as it is called, "spot" gun-fire. This use which has been developed in practice by naval officers, especially in our navy, has the effect of greatly extending the range of heavy guns.

As everyone knows, the dip of the sea horizon limits the visibility from ships even from the fire-control platforms which are about 120 feet above the water. This formerly limited the effective range to less than 20,000 yards. By means of aircraft however, gun-fire may be controlled for much greater distances than this and, due to the height at which planes operate, the fall of projectiles may be observed even more accurately than from aboard ship at materially shorter ranges. It is easy to see the great importance of this developed use of aircraft, since it so materially extends the range of naval guns. Navies now employ the high-speed fighter type of plane as well to protect their spotting, observation, or bombing planes, the large carriers being well adapted to carrying this type of plane.

Merchant vessels compose a highly important part of naval strength and resultant sea power—an indispensable part to any country having overseas possessions that are not self-sustaining, and to any country dependent on imports of food, fuel, or essential com-



Photos Courtesy of Field Museum of Natural History

X-Rays Reveal Diseases of Ancient Egyptians

THERE is a fairly widespread belief that the human frame is subject to many more ills in modern days than it was in the "good old times" before over-civilization became a "menace" to it. We are rather inclined to be surprised, therefore, when we discover tangible evidence that many of the same ills that beset us today also beset our earliest ancestors. There is perfect evidence, for example, that the owner of the famous Rhodesian skull of primitive man suffered severely from abscesses and toothache. Professor G. Elliot Smith, the noted British anatomist, has brought to light in early Egyptian mummies the evidence of many modern forms of disease. And

now, from the great Field Museum of Natural History in Chicago, come three remarkable pictures of Egyptian mummies of children whose skeletons, studied by means of new X-ray apparatus installed for that purpose, exhibit pathological peculiarities. The studies were made by Dr. Cora A. Matthews of Cook County Hospital.

The two mummies at the right exhibit curvature of the spine, a condition due to incorrect sitting posture. School health authorities continually combat the same evil today.

The mummy on the left is that of a baby whose bones show evidence of rickets, due without doubt to malnutrition.

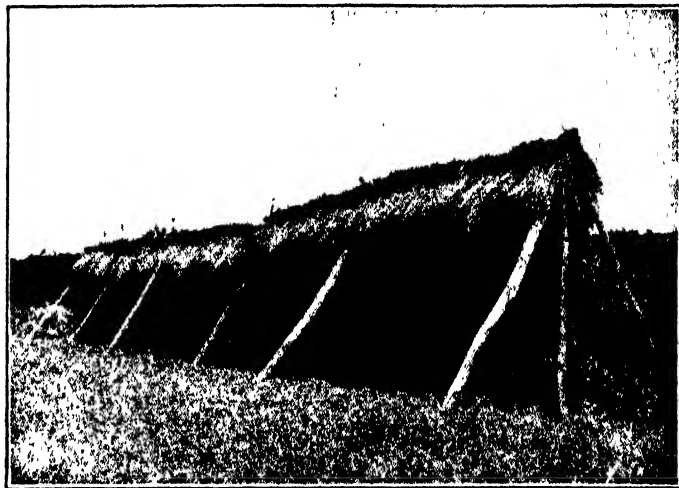
Primitive versus Modern

Menthol, Distilled From Oil of Peppermint Is Produced at a Lower Price by Americans With Better



JAPANESE PEPPERMINT

The peppermint plant grown in Japan is much slenderer than the sturdy herb of the same variety that is now being grown in America



MINT DRYING RACK

In Japan, mint dries on such racks for weeks; in California, it is ground-cured in 36 hours, and gathered in the morning while wet



CRUDE STILL

Dried vines are used as fuel in this Japanese still. The mint farmer must stay on the job continuously to keep the hay-fire from going out



HARVESTERS

One farm hand in America makes more than this entire group of Japanese mint harvesters. Low wages favor the Japanese employer

THE Japanese mint farmer, with manual labor and crude apparatus, can produce menthol at a lower cost than American growers who have apparently everything in their favor—greater yields per acre, the most modern labor-saving machinery, and no ocean freight to add to their selling price.

For years Japan has produced the bulk of menthol used in the world. It is derived from the oil of Japanese peppermint, the cultivation of which has practically amounted to a government monopoly, so profitable has it been.

About six years ago, during the period of high prices following the war, American manufacturers of salves, cough drops, et cetera, who used menthol in their products, became interested in making experiments for growing the mint in this country.

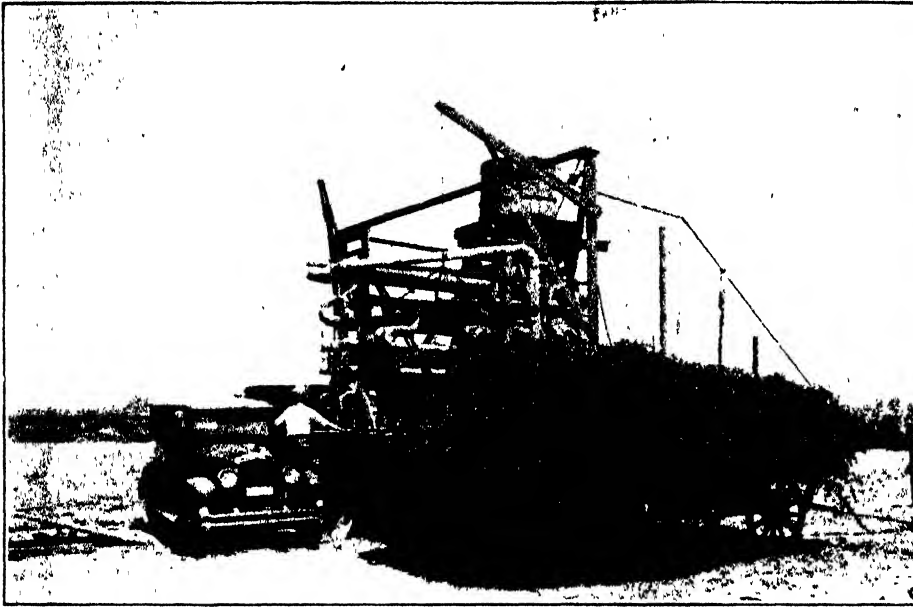
Subsequently a few plants were imported, and a few years of experimentation proved that the oriental herb

flourished remarkably well here—in California at least—and the acreage was increased at a rapid rate. Two years ago the first commercial crop was produced at Porterville, California, but it amounted to only a few gallons of the crude oil. However, some important facts were proved; namely, that the Japanese peppermint plant is very hardy, will withstand heat and cold, and will thrive with much less moisture here than in its native soil in Hokkaido, a northern island of Japan, where the annual precipitation averages over 40 inches. Moreover, the individual plant has a stockier growth and heavier leaf development here, and yields a greater tonnage per acre than in Japan. As much as 100 pounds of oil per acre per season has been produced near Porterville, while in Japan 40 pounds is considered an unusual yield. The menthol content of the California-grown oil is around 70 percent, which also is in excess of the Japanese product.

The Californian, therefore, has everything to his ad-

Methods of Mint Farming

and Used in Medicaments and Confectionery, Japanese Mint Farmers Than by Equipment and Methods



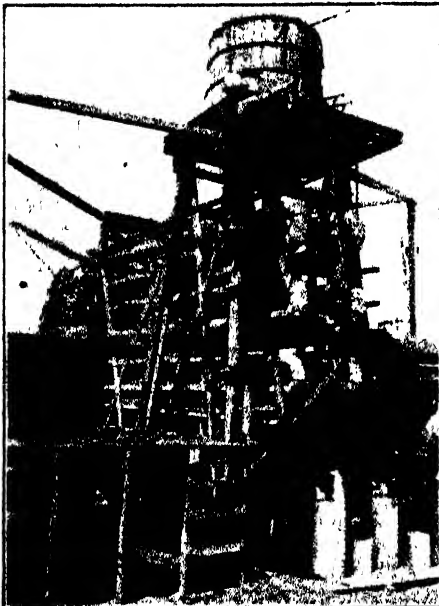
CALIFORNIA MINT

A load of American-grown mint, ready to go into the still. About 100 acres of the Japanese variety are now under cultivation in this country, Porterville being the center of the industry



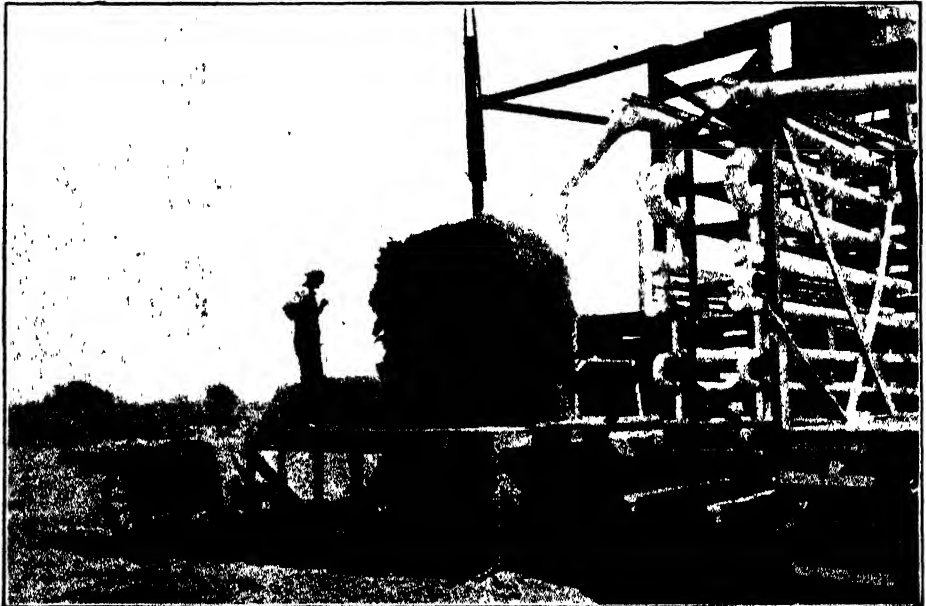
TESTING DISTILLATE

The amount of oil that rises in water shows whether charge is nearing exhaustion of oil



CONDENSING COILS

Water from the tank above sprays over the cooling coils, and the oil is drawn off below



REMOVING EXHAUSTED MINT HAY

Four tubs, similar to the one shown, are installed at this still. Two tubs are steaming while the other two are having their exhausted charges removed and are being re-charged with hay

vantage in the cultivation of the plant. He does his original cultivating with a tractor, and harvests with a mower, whereas his Japanese competitor does all this laboriously by hand.

In the distillation of the mint hay, the American farmer has a modern still with a capacity of from three to ten tons of hay daily, and a production of from 50 to 150 pounds of oil daily. On the other hand the Japanese farmer produces only five to 15 pounds of oil per day, and

must work steadily for 24 hours to run through a single charge of perhaps less than half a ton of hay, for his fuel of dried bean-hulls and leaves is so light that he cannot leave his still for more than a minute or two. If the charge "goes dead," his loss is considerable.

Yet in spite of these laborious methods and the crude apparatus of the Japanese, he is able to deliver his menthol, or his oil, in New York at a price lower than is profitable for the American farmer.

Combating the "Bends"

Careful Regulation of Working Hours, and Better Equipment, Lessen the Danger to Workers Under Pressure

By ALBERT A. HOPKINS

COMPRESSED air is of great importance in engineering work. Subaqueous tunneling, foundations for bridges and buildings, and deep mining operations involving water could not be carried on without its aid. In the general engineering construction going on around centers like New York, a surprising number of men work under varying degrees of air pressure. The effect of compressed air upon the life, health, and efficiency of workers is therefore of necessity intensively studied by medical men.

One who has specialized in this subject is Dr. Edward Levy, physician, Transit Commission, New York, and consulting physician for the New York State Bridge and Tunnel Commission and the New Jersey Interstate Bridge and Tunnel Commission, to whom we are indebted for the following facts which are based upon his report published by the Bureau of Mines, of which he is consulting physiologist.

IN tunnel work, an air-compressing plant is erected near the main vertical shaft from which the tunnels are to be driven. Screened air passes from the compressor to a large receiving tank, from which, because of the great heat developed during compression, it is forced through a cooler in which water is circulated and the temperature of the air is greatly reduced. Through suitable piping down the shaft and through the tunnel bulkheads it is led into the working chambers. To ensure an uninterrupted supply, all the air lines are in duplicate.

In tunneling, a "shield" is usually used. As the shield advances, the tunnel lining is erected directly behind. This is carried on until the two shields meet, if the tunnel is driven from both shores, or until the single shield enters a shaft at the other end.

Caisson disease, compressed-air illness, or, more properly speaking, air embolism, is a condition caused by a too rapid decompression after exposure to higher pressures for a period of time. It is characterized anatomically by the presence of free nitrogen in the tissues and body fluids, and clinically, by one or a combination of the following symp-

ptoms: localized pain, vertigo, prostration, or symptoms referable to the central nervous system. Many theories have in the past been advanced as to the cause of compressed-air illness, but it is now universally agreed that the true cause is the presence of free nitrogen in the various parts of the body, interfering with their normal functions.

In an employment as hazardous as that of a "sand hog," attention must be paid to the class of men best fitted for it. Perhaps too much has been said in favor of thin men, young men, and athletic men generally. During the war, the Commission was forced to employ men that were very mediocre physically. Actual experience has led

individual who seeks such employment.

The out-door temperature in New York in the four years in which the work of the Public Service Commission was in progress, ranged from -13 degrees to 102 degrees, Fahrenheit, but the records indicate that temperature has little, if any, influence on increasing the number of cases of compressed-air illness. Moreover, humidity does not seem to cause any increase, although its effect is evidenced by increased fatigue. In the working chamber the temperature was always about 77 degrees, Fahrenheit, even during a hot wave which caused over 200 deaths and 2000 prostrations in the open air, as reported by the press.

The records show that the number of cases of compressed-air illness depends upon the length of time the subject has been under pressure, the height of the pressure, and the length of time taken by decompression.

NO case of compressed-air illness occurred until the pressure of 15 pounds was reached, although the number of decompressions by that time had reached 188,496. The number of cases that resulted from working in pressures of 15 to 22 pounds was 16, and they were all trivial, so it seems safe to subject normal, healthy men to pressures ranging up to 22 pounds for a period of eight hours.

For pressures of 22 to 30 pounds the shifts were divided into two three-hour periods, with a rest interval of three hours. There were 301 cases in 320,681 decompressions. In the next stage with pressures running from 30 to 35 pounds, the shifts being divided into two two-hour periods with a rest interval of two hours, the record shows there were 250 cases to 265,162 decompressions, the higher pressure of 34 pounds furnishing 113 of the 250 cases. From 35 to 40 pounds the shifts were divided into one-and-one-half-hour periods with a three-hour interval for rest. There were 41 cases and 57,716 decompressions.

The hours of labor just cited do not mean the actual time spent in compressed air, but the time spent in working at the face of the shield. Where the work is far advanced, the working face may be at the middle of



ENTRANCE TO MEDICAL AIR LOCK

A doctor is always on hand to recompress the person injured by air pressure. The patient is entering the air lock

to the conclusion that in the selection of men the essentials are normal lungs, normal kidneys, and a good heart; in the older men the blood pressure must not be high. Tunnel workers range from 20 to nearly 60 years of age; the older men finding it necessary to give fictitious ages in order to obtain work. In reference to the employment of fleshy men, it has been found that such men are not more susceptible to compressed-air illness than is the average

the river, and much time, therefore, would be consumed in walking from the shaft. In one instance when the men were working under 48 pounds pressure, the length of time actually spent under compression was 125

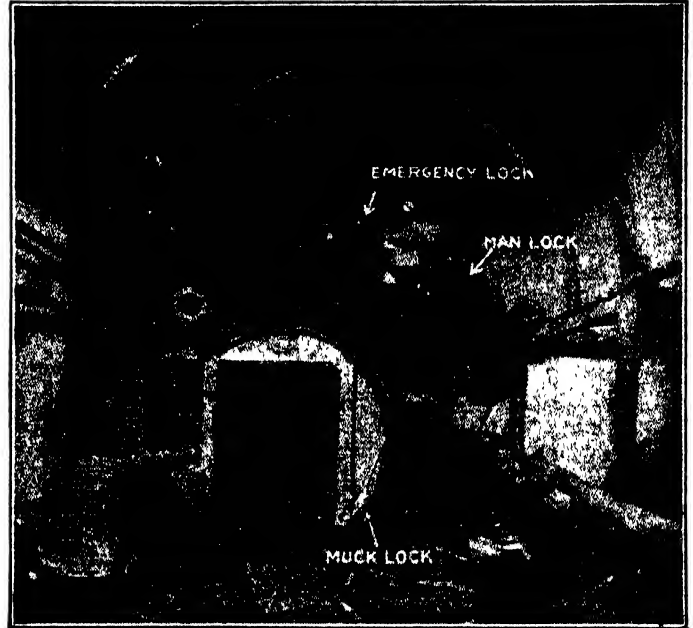
until equilibrium with the normal atmosphere is established. Should the decompression be so rapid as not to permit enough time for the blood to carry the nitrogen freed from the tissues to the lungs, or should the

Levy is convinced that compressed-air illness could be limited to cases of localized pain if the hours of labor are properly adjusted and a reasonable length of time for decompression is permitted.



DOCTOR IN MEDICAL AIR LOCK

The medical air lock is a boiler 18½ feet long. In serious cases the doctor enters also and controls the pressure valves from within



THE BEGINNING OF A TUNNEL OR SHAFT

The man lock is for the workmen, the muck lock is for excavated material and the emergency lock is for escape in case of accident

minutes, although they were credited with working only two shifts of 45 minutes each, or 90 minutes total.

To determine safe working hours, comparison with previous large tunnel works of a similar nature must be made. The work on the Pennsylvania tunnel beneath the East River (1904-1909) was well conducted, excellent records were kept and the tables show that under a pressure of 40 pounds, for a period of one month, there was 1.63 percent of compressed-air illness. In the Public Service Commission tunnels in pressures above 40 pounds during the entire work the percentage of cases scarcely exceeded 0.1 percent.

The effect of gases, including carbon dioxide, carbon monoxide, oxygen, and nitrogen forms the subject of much research which cannot be gone into here owing to the complexity of the problem. During compression, the blood while going through the lungs takes up nitrogen to its point of saturation, which increases approximately 1 percent for every additional atmosphere of pressure applied. This nitrogen-saturated blood in its circuit about the body delivers its nitrogen to the less saturated tissues and fluids and returns to the heart ready to be re-saturated and again deliver its nitrogen to the tissues.

In decompression, the action taking place is the reverse, the super-saturated tissues giving off nitrogen to the blood, which is de-saturated by going through the lungs. The blood is again saturated with nitrogen from the tissues and de-saturated in the lungs, and so on.

lungs be incapable of ridding the blood of the excess nitrogen, gas bubbles of nitrogen will form in the body fluids and tissues. The formation of gas bubbles is the accepted theory of the cause of "caisson disease" or "bends."

THE symptoms of compressed-air illness are: disturbances of the central nervous system which may be either motor or sensory, due to the pressure of air emboli upon the brain or spinal cord; localization of pain in the muscle fiber, tendon sheath, bone or nerve terminal, depending on where the gas emboli is present; dizziness, as the result of gas emboli in the middle ear or caused by disturbances of the central nervous system; difficult breathing or "chokes" due to bubbles of gas forced through the pulmonary arteries into the lungs; unconsciousness, or collapse, usually caused by large quantities of gas distributed generally throughout the circulation.

Cases classed as localized pain, vertigo, and "chokes," can usually be relieved by re-compression. Symptoms due to affections of the central nervous system can ordinarily be relieved by immediate re-compression, but if re-compression is postponed, destruction of the nerve elements may result and more or less permanent injury is to be expected. Unconsciousness and collapse with abdominal pain, in which a comparatively large amount of air is present in the circulation, indicate grave danger, although if treatment is prompt, recovery should follow. Dr.

The medical air lock used in connection with compressed-air work is a steel cylinder six feet in diameter and 18 feet six inches in length; one end is entirely closed and the other end has an entrance door opening inward. The cylinder is divided into two compartments of equal size by a partition with a door that opens toward the inner compartment. Both compartments contain cots on which the patients may recline. The lock has electric lights, telephone, clock, pressure gage, thermometer, electric heater, and suitable provisions made for ventilation.

The compressed-air pipes and outlet valves are so arranged that the pressure in either of the compartments can be regulated from outside the medical lock, or either compartment may be regulated from the one in which the operator happens to be. Heavy glass windows of the bull's-eye type are placed in line over both doors so that the patient, pressure gage, and thermometer can be watched from the outside. In more serious cases the doctor enters the air lock with the patient as shown in our illustration. As a drop of 20 pounds in a short period causes a rapid fall in temperature, men are provided with blankets so that they will not be chilled.

The sinister looking air lock is indeed a humanitarian device which permits men to work in compressed air with a minimum chance of injury, and the "sand hog" probably receives more careful medical attention than almost any other class of worker.



IN THE LAND OF MOAB

Watching for the steam to come out of the wheels. This group of natives never saw a locomotive before

IN every great museum there are gaps or bare spots which interfere with the orderly presentation of cultural objects. It is one of the functions of the director and curators to try to remedy this condition, and except in the case of paintings or other works of art, there is usually but one method to be pursued, namely, an expedition.

The Metropolitan Museum of Art possesses one of the finest and best balanced collections of armor in the world but even here and there is a bleak spot. Armor dating from the time of the Crusades is extremely rare, and there is no place so likely to offer specimens as Palestine, which was to all intents and purposes a section of Europe for a period of two centuries.

THERE is so much glamour and romance about the Crusades that almost any fragment or article rises to importance. Under the Turkish regime, excavations were forbidden. In 1925, Dr. Bashford Dean, the Curator of Armor of the Metropolitan Museum,

made a preliminary survey and after consultation with the archeological authorities of Palestine, the crusading fortress of Montfort was selected as the best site for exploration. The castle was situated half way between Acre and Tyre and only about six miles from the sea. The location was so remote from any city that it had never served as a free source of building material. Although dismantled and abused, it still remained very much as the besiegers left it.

It is at this point that the writer enters the picture. To one who has made digging a pastime of a lifetime, an offer of the leadership of an expedition of this caliber was a lure which could not be resisted. If there was any resistance at all it was feeble.

Our trip to Northern Palestine for the exploration of the Crusader Castle of Montfort, briefly described in the February, 1928, issue of the SCIENTIFIC AMERICAN, was beset with no actual dangers, although we met with some difficulties, and had some experiences which may be worth the relating.

THE journey up from Haifa was crowded with original experiences. Our car had hardly reached the beach before we came upon the vultures who pick up their living along the shore. A little farther along there was a touch of homeliness to the scene where at the highest ripple mark there was a continuous rosary of grape-fruit rinds, and we were reminded that there was a "Mediterranean Cruise" ship in the Bay of Acre.

We met our first caravan, a long one, on its way down from Syria. We rode over the drag ropes of a net which was being hauled in by a dozen sturdy fellows, a labor which might more profitably have been performed by a small gas engine. We saw an iron ship which had been driven high upon the beach; it was now cut in two, and was ready for launching as two separate boats.

On approaching Acre we crossed the Belus River near its mouth. We halted

the car and photographed the spot were Pliny tells us, glass was first accidentally made by Phoenician merchants who made a fire of seaweed and noted the flux of the fine sand resulting from the alkali and heat of their peculiar fuel.

Probably no explorer ever had a more attractive site for his operations than Montfort. The castle is located on the crest of a wooded and flower-bedecked hill, about whose base meanders the Wady Kurn. We have done a bit of digging in our time, but we confess that we were dismayed by the extent of the ruins; they were over 300 feet long. Once fairly started, however, we realized that the proposition resolved itself into a mere question of good weather and sufficient help.

ALTHOUGH the medieval armor which we sought at Montfort proved to be very fragmentary, and rusted to the last degree; and while the lance and arrow points were few in number, our quest was successful to



DRUMS DISLOCATED BY AN EARTHQUAKE

Corinthian capital at Jerash, Roman city, showing drums dislocated by earthquake



CRUSADER'S CASTLE IN LAND OF MOAB

Revetment of the Crusader's castle at Kerak, Transjordan, shows military engineering

Exploring in Palestine and Transjordan

An American Explorer Tells of His Travels and Discoveries in the Holy Land

By W. L. CALVER

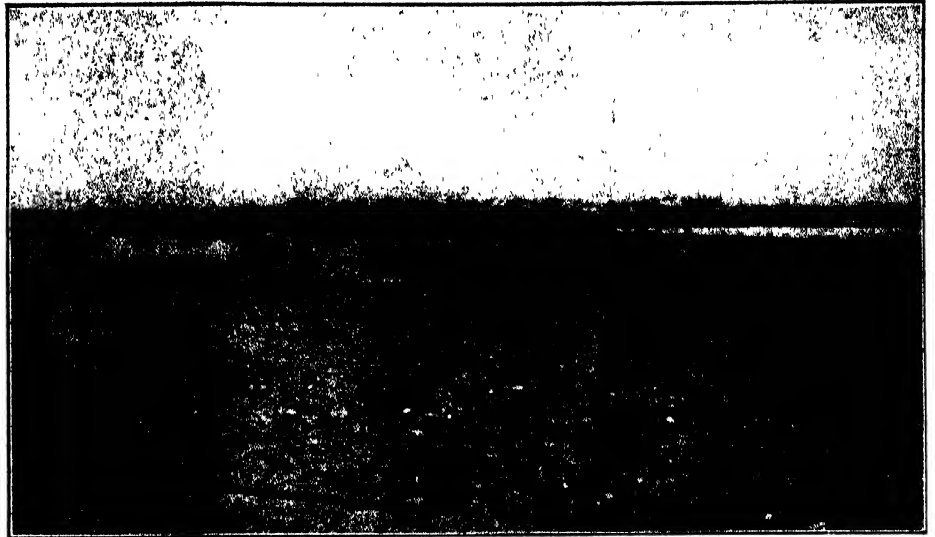
Director, Montfort Expedition

the extent of finding various kinds of other material which revealed the character of the castle's architecture and the daily life of its occupants.

Most conspicuous among the mementos recovered from the several chambers were the immense stone balls from the *trebuchets* of the besiegers; the identical missiles, 57 in all, which encompassed the downfall of Montfort Castle. The exploration here is more fully described in the article referred to above.

Within the old Turkish Arsenal at Acre, where our Montfort material was deposited, serving as a nucleus of a collection of antiquities to be exhibited there, are many objects which well serve to illustrate warfare as it was waged 100 years ago. In the courtyard we noticed bar-shot and fire balls, while within an alcove we saw boxes of paper cartridges for old muzzle loading muskets, and masses of gun flints of many patterns spilling out of their original cases. We were permitted to carry away a few samples of these flints which present some remarkable fine flaking, tending to prove that flint chipping, distinct from the ordinary "napping," was an art practiced by white men up to 100 years ago.

OF the one or two instances when the Orientals actually "put one over on us," we say nothing. We congratulated ourselves, however, in that we withstood the lure of a Samaritan who tempted us in the vicinity of Nabulus. When we alighted from our car to visit Jacob's Well, standing by the roadside near the gate, there was an aged Samaritan who offered for sale a tray full of beautifully iridescent little glass bottles, all whole, but set around with equally beautiful fragments of nondescript glass. One word only of his jargon we understood—"Antika;" but in sign language he led us to believe that his attractive curios were



ACRE AND THE BELUS RIVER

Here on the Phoenician strand the first discovery of glass was made. Pliny tells us how Phoenician merchants made a fire of seaweed and noted the flux made from the sand by the alkali



REPUTED HEAD OF CHRIST FROM JERASH

Sculptured head found in the Roman city of Jerash in Transjordan. It is supposed to date from the Second Century A.D.

derived from excavations in progress on the hill nearby.

We promised ourselves that when we journeyed that way again we would buy him out. But when, at Jerusalem, we confided our intentions to some acquaintances there, they bestowed upon us looks of pity. When we asked whether there could be any doubts as to the genuineness of the Samaritan's "antiques" our friends assured us that the iridescence was the real thing all right, but the bottles were quite modern. The Samaritan had scraped the iridescent flakes from ancient glass fragments, obtained from local diggings, and had attached them, with their beauty undiminished, to the surface of his modern bottles by means of some kind of mucilage.

Our tour of Transjordan was begun on March 6th, when we went down to Jerico and passed the Jordan by the Allenby Bridge, and reached Amman near the close of the day. The modern Jerico is only about 16 miles in direct line from Jerusalem, yet one travels several miles more than that on his way down. The drop is about 3600 feet.

IT is quite generally known that the Dead Sea, from which Jerico is only a few miles distant, is 1000 feet below sea level, but few are aware that Jerusalem is about 2600 feet above the sea. So great and sudden is the drop that when one goes down by car, his ears ache. At a point where our car in its course downward nearly stood on end, we asked to be assured about the brakes, and requested that the chauffeur favor the bank side of the thoroughfare rather than the extreme outer edge of the road.

We began our long trip down through the Land of Moab toward El Kerak, a populous and extremely ancient town about a dozen miles east of the Dead Sea and 8100 feet above sea level. Of



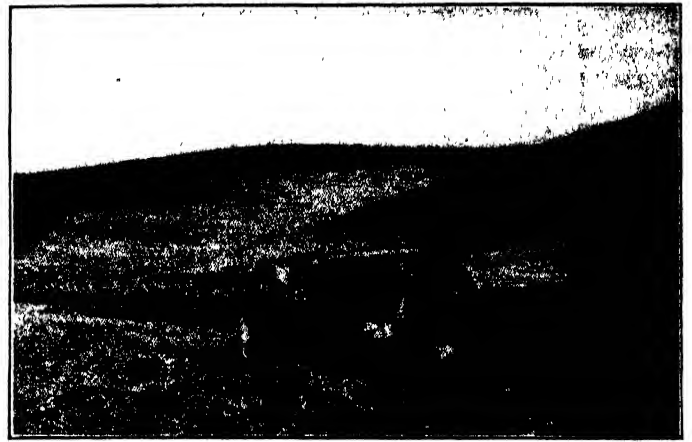
AUTHOR'S CAMP AT MONTFORT

The camp was situated below the Crusader's castle at Montfort in Palestine. All the picturesque features of the Orient are there, even to the camels. American push and efficiency was a novelty



THE HEJAZ "EXPRESS"—TWICE A WEEK

Rear end collisions are rare on this road. Nine freight cars, a passenger coach and a caboose form the equipment of the train



STUCK IN THE MUD

Automobiles are in general use in Palestine and Transjordan. Here all the party are trying to extricate the author's car from a mud hole

the route pursued our diary says: "good road;" "poor road;" "track only;" "no track." Following the Hejaz Railway, on its way to Mecca, we arrived at lunch time at Kutrani station on the Hejaz. Two trains per week, we were told, was the schedule, and as we approached the station a train from the north pulled in. Nine small freight cars, one passenger coach and a caboose, made up the train, besides the locomotive.

THE passengers, we supposed, were all pilgrims. The train remained at the station above half an hour. Arabs, apparently of the leisure class, jibed the soldier guard, while other Arabs inspected the locomotive, speculating how the steam got into the wheels, while we sized up the two water tanks near the station which had been shelled during the war. From the engine of an Australian airplane, which had been brought down by the Turks, we pried off a brass plate which stated: "This cylinder is 1/1000 large" for a memento.

After many farewells to newly-made friends at the station, the pilgrims bundled back into the single passenger coach, the engineer rang his bell, and

the train started again for Arabia. About this time we regretted that no view of the tra'n had been taken, but when the train had proceeded about two lengths from the station, the engineer seemed to have forgotten his

monkey wrench, or oil-can, or some little matter of business, so he halted the train and then backed to the station. We embraced our opportunity and snapped the engine and train head-on.

Our first contact with the ruins of the Roman outpost Jerash was when we came upon the detached triumphal arch. This well preserved and beautiful work of pink limestone is close beside the present road, yet some distance outside the line of the city wall.

THE structure consists of a central arch 21 feet wide, and there are smaller gateways at each side. The whole building has a total width of 83 feet. This florid bit of architecture has lost many of its embellishments. The calyx-shaped pedestals of acanthus leaves above the bases of the columns being now about the only carvings visible, there probably remain buried in the rubble within and about the monument, the sculptured ornamentations of the southern front of the arch.

On our arrival at the modern Circassian village of Jerash, built from the ruins of the ancient city, we became the guests of Mr. Horsfield, who for the past eight years had been engaged



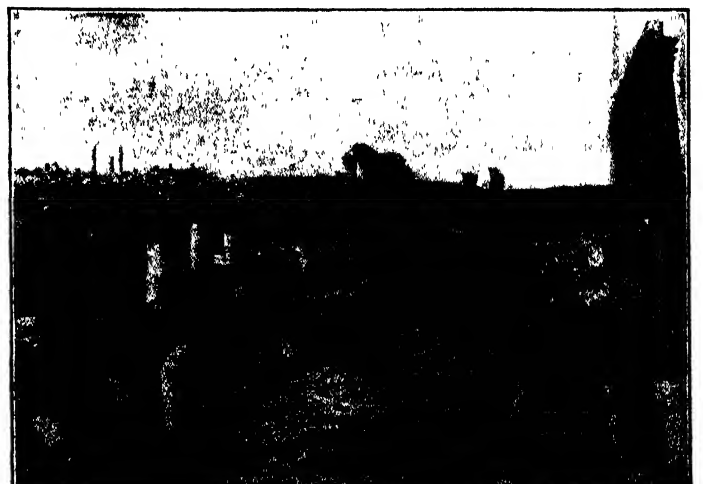
FINE EXAMPLE OF EROSION

The bridge on the way to Kerak, showing roads and how the countryside is eroded



TRIUMPHAL ARCH AT JERASH

This beautiful arch is built of pink limestone. The central archway is 21 feet wide. There are smaller gateways located at each side of it



THE COLONNADE AT JERASH

The natives have destroyed much of the colonnade by burning the drums and capitals for lime. Still the remains are quite substantial

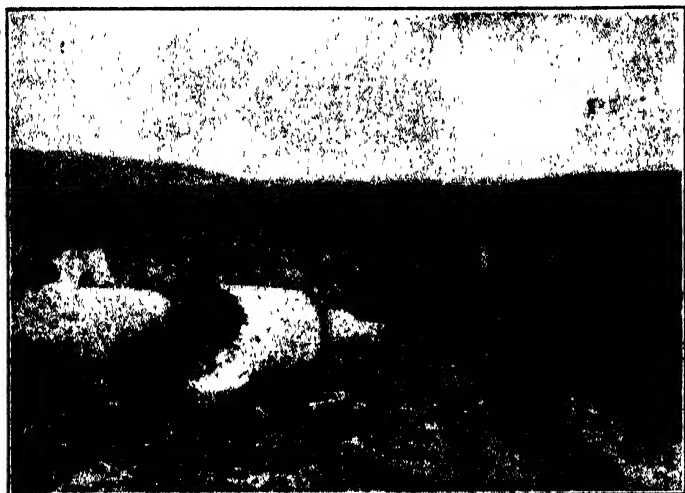
in clearing the Roman ruins. Mr. Horsfield rather resented being classed as an archeologist, yet as an architect he was certainly qualified for his task.

Towards the close of the day the clouds broke away and there was a beautiful rainbow in the east. Under

capitals, friezes and sundry decorations for lime, while they appropriated the dressed rectangular stones for the construction of their simple dwellings.

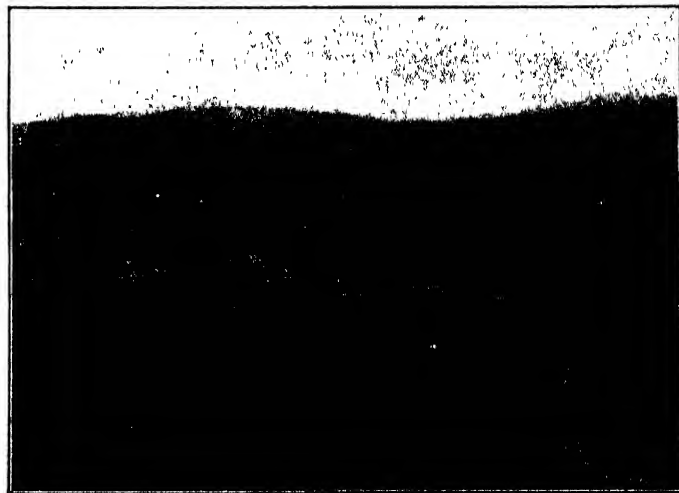
Apparently little is known of the history of Jerash. The first mention of it occurs when Josephus relates that

country men at Caesarea, at the commencement of their last war with the Romans; and it had scarcely recovered from this calamity when the Emperor Vespasian despatched Annius, his general, at the head of a squadron of horse, and a large body of infantry, to



EXPLORATION AT JERASH

Exploration at Jerash has been carried on by Mr. Horsfield for the last eight years with notable results. A contractor's railway helps



THE FORUM AT JERASH

A beautiful view of this old Roman city is obtained from the hillside. City of Jerash was an important Roman outpost of the later period

these conditions we got our first good view of the long colonade with its many standing columns. We noted the several distinct structures—the tribune, the two theaters, and the several temples, wondering meanwhile at the untarnished character of the masonry and the lack of publicity which this remarkable site had received.

WE recalled however, that in our youth we had read that there existed in Asia Minor a beautiful Roman city, almost intact; and that it was fast being obliterated by vandal natives who were burning its ornate

Alexander Jannaeus, King of the Jews, having subdued Pella, directed his march to Gerassa—as it was known to the ancients—and carried the city by assault. (Circa, 85 B.C.) Its most prosperous period was early in the Christian era. Soon after the Roman conquests in the east this region became one of their favorite colonies. Ten cities were built, or rebuilt, and the district was called "Decopolis." Of the ten cities, Gerassa was the most important.

The old guide book says: "It was among the cities which the Jews burned in revenge for the massacre of their

capture it. Annius having carried the city on the first assault, put to the sword 1000 of the youths who had not effected their escape, enslaved their families, and permitted his soldiers to plunder their property. He then set fire to their houses, and advanced to the villages around."

It appears to have been more than half a century subsequent to this period that Gerassa attained its greatest prosperity, and was adorned with those monuments which gave it a place among the proudest cities of Syria.

QUITE recently Jerash has come prominently into notice through the discovery among the ruins of its fifth century church of what is supposed to be a very early, if not the earliest, sculptured head of Christ. This head, found by Mr. Horsfield, has been a subject of some dispute. There can be little doubt however, that in its present form it represents the saviour, although there are evidences that in an original form it portrayed a pagan deity, or hero of the classic period—Greek or Roman. Yale University, co-operating with the British School of Archaeology, is about to excavate a portion of the city of Jerash. Particular attention will be paid to the early Christian church.

It has been said that little is known of the history of Jerash, yet we found in the modern Circassian village many coins of the ancient city, and in these might be found the record of this outpost, Greek in its origin, but Roman in its flourishing days, and until its downfall. Among the coins found we noted a silver *drachma* of dating to about 300 B.C.



TEMPLE AT JERASH

Earthquakes have thrown down many of the columns. Where the tilting caused by the tremor is insufficient to overthrow the column, the drums have slipped as shown in a previous illustration

Why Is a Radio Soprano Unpopular?

Present-day Radio Laws and Radio Equipment Make Proper Reproduction of Soprano's High Notes Impossible

By JOHN F. RIDER
Associate Editor, Radio Engineering

NOT so long ago, an elderly gentleman whose aristocratic appearance was impaired by a distinct frown, entered a radio store and addressed the clerk as follows—"You sold me a receiver sometime ago. I wish you would send some one to my home to fix my set, I hear nothing but screeching sopranos. Here is my address. Thank you."

The above is a concrete illustration of the attitude of the general radio public toward the soprano as a broadcaster. This state of affairs is indeed unfortunate, because the soprano upon the concert stage is one of the most popular, if not the most popular, of artists. But, why is the soprano disliked as a broadcast artist? We, who like the soprano upon the concert stage, do not prefer her over the radio. Our friends, who like the soprano upon the concert stage, do not prefer her over the radio. A survey among radio enthusiasts who consider radio as a medium of musical entertainment and education, shows a general dislike for the radio soprano. As much as we would like to state that she is a de-

lightful radio artist, we cannot in justice to other radio performers speak in the affirmative.

The art of radio reception, marvelously developed as it has been during

A Question Answered

ON the concert stage, you enjoy greatly listening to your favorite soprano. One evening you see in the radio program published in your local paper that she is to broadcast. With anticipation you tune in carefully and settle back to revel in the sweet beauty of her voice. The announcer . . . the opening chords . . . the soprano herself . . . and a rude awakening. Soul inspiring on the stage . . . a veritable "flop" on the radio is the sad lot of the soprano. Why? The question is answered in these columns by one who has made a careful study of the whys and wherefores of radio instruments, and answered in a way that gives all of the reasons.

The Editor.



BEAUTY AND THE "MIKE"

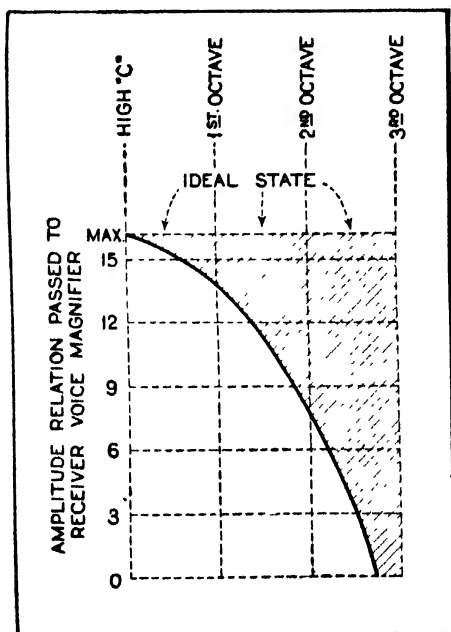
The lot of the radio soprano is a hard one. Radio instruments seem to conspire to prevent the successful broadcasting of her voice

fortunate for the artist because it means the preservation of her reputation, which justly belongs to her.

The reasons why radio is not yet ready for the soprano are numerous. In the first place, the speech characteristics of woman in general, with respect to aural comprehension, are inferior to those of man. Dr. J. C. Steinberg of the Bell Laboratories, states in *The Bell Laboratories Record* that women are found to talk less distinctly than men. Secondly, the speech characteristics of woman, when changed to electrical impulses, do not blend with the electrical characteristics of our present day radio equipment. Thirdly, the demand of the radio public for radio equipment to meet their aural fancy has led to design of equipment that impairs the reproduction of a soprano's voice. Therefore, we see that the reasons for the enigma are both physical and electrical.

IT may sound strange to hear that man is more readily understood than woman, and that for radio transmission a man's voice is better than a woman's. Nature has so endowed women that they can more easily pronounce such words as "thin" and "fat," such sounds as "th" and "f," but these sounds are most difficult to hear. Dr. K. S. Johnson of the Bell Telephone Laboratories says in his book on telephone transmission circuits, "'th,' 'f' and 'v' are difficult to hear, regardless of the intensity, and account for over 50 percent of all the errors occurring in commercial telephone systems. . . ." Our radio equipment is very similar to that used in telephone practice and effects found in telephone practice hold true in radio.

For a basis for determining why the soprano is not a satisfactory broad-



IN STATION SELECTOR

Tuner reduces intensities of higher octaves. Curve may be straightened in the future

the past eight years, is not yet ready for the soprano as a broadcasting artist. It is unfortunate, but true. Innumerable music enthusiasts who have never had the occasion to listen to a popular artist upon the concert stage but who have heard of her reputation and anticipated a delightful rendition of their favorite song, have been sadly disillusioned when she was heard via the air. This statement is made in direct contradiction of the wide acclaim supposedly accorded to some of our famous sopranos upon their radio performance. The heralding of the appearance of a famous soprano at a well known broadcasting station, immediately creates a favorably biased opinion. The reputation naturally precedes the performance. If the performance is unsatisfactory, as it invariably is to those well versed in musical lore, some excuse is hurriedly found. Seeking an excuse to justify the received performance is in order, so as to reconcile one with the disappointment. That this is done is indeed

casting artist, we must delve somewhat into the physical and the electrical. Speech sounds in general are not simply tones but, on the contrary, are quite complex. Analysis of a tone, complex in nature, shows that what we hear consists of a number of individual tones of varying intensity. That is to say, a complex tone or sound consists of a fundamental tone and a number of harmonics and overtones. In contradistinction to musical instruments such as the pipe organ and the tuning fork—which instruments produce pure tones consisting of just one value of vibrations per second, or frequency—human speech sounds are quite complex and consist of a number of values of vibration per second, or frequencies.

In other words, a certain speech sound may have a fundamental of 300 vibrations per second and a number of harmonics of say 600, 900, and 1500 vibrations, or cycles, per second. The timber of a sound or its complete tone is governed by the relative amplitudes of the fundamental and its associated harmonics. Decrease or increase the relation of the fundamental and harmonic amplitudes or intensities, and the timber of the audible sound has been changed. Herein lies the basis for the recognition of the various musical instruments or the recognition of a human voice. The preponderance, the absence, the variation in amplitude or intensity, and the number of harmonics present, provide the distinguishing characteristics between musical instruments and the speech of humans.

UPON analysis of the voice range of a soprano, it is found to extend from the "B" just below middle "C" on the piano to the "F" above the second "C" octave above middle "C" on the piano. Interpreted in the number of vibrations per second, the range extends from approximately 240 to 1365. This is the range of fundamental notes within the range of a soprano's voice. Singing a note within this range does not mean that only that note is present, as we hear it. The sound emitted by the singer contains the fundamental and a number of its associated harmonics.

Analysis has shown that the closer the fundamental to the high limits of her voice range, the fewer the harmonics and, conversely, the lower the fundamental within her voice range, the greater the number of harmonics. At all times, however, we must contend with a fundamental and a number of harmonics. The musical value of any tone or note is due to the presence of the harmonics. Remove all the harmonics and the tone has been changed to a sound devoid of all mellowness or sweetness or richness. If the original note is high, such as high "C" sung by a soprano, and all the harmonics are removed or attenuated or

diminished, the final sound will be a shrill shriek or whine, entirely unmusical. In fact it is not essential that all the harmonics be removed or diminished. Accentuation or attenuation of some of the harmonics will produce disagreeable effects.

THE loss of overtones and harmonics, and the accentuation of some of the harmonics are the reasons for the defeat of the soprano as a radio broadcast artist. Present day radio instruments are not equipped to transmit and respond faithfully to the overtones and high harmonics of a soprano's voice.

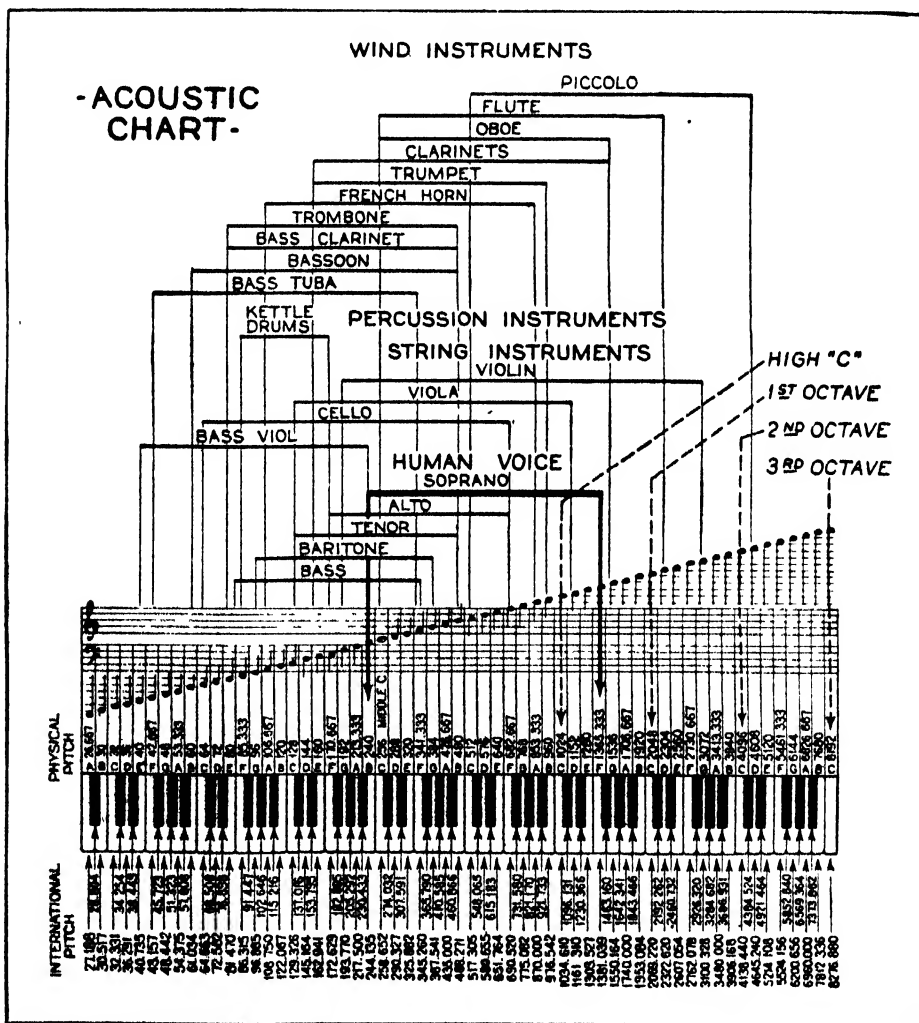
A simple example of this phenomenon in everyday radio reception, is a duet between a tenor and a soprano, or a baritone and a soprano. In both instances, the soprano's voice is lost; the male voice predominates.

A soprano appearing upon the concert stage sings to a listening audience. Her voice is carried through a medium, the air, which does not attenuate or accentuate the frequencies produced by her vocal cords. Distance will diminish intensity but will not vary the amplitude relation between the fundamental and the harmonic fre-

quencies produced by her vocal chords. The ear of the audience to whom is conveyed directly through the air the relative amplitudes of fundamental and harmonic vibrations, without attenuation or accentuation, hears the sweetness and richness of the soprano's voice. With the air as the only transmitting medium, without accentuation or attenuation of harmonics, and with the wide response range of the human ear, the listener hears a delightful performance. The same singer, performing over the radio, sounds disagreeable.

THE human ear is both a sensitive and an insensitive organ. It is sensitive in varying degree to pitch, being uniformly sensitive to the normal fundamental ranges of the soprano's voice. On the other hand, the human ear is a poor judge of intensity. With respect to pitch variations, however, we find a variation of approximately .3 percent as being perceptible over a soprano's voice range.

We have said that a pure tone is not musical, that the sweetness of a tone is found in the combination between the harmonics and the fundamental. Now let us suppose that a soprano sings high "C." This note is of approxi-



ACOUSTIC CHART OF THE PIANO SCALE

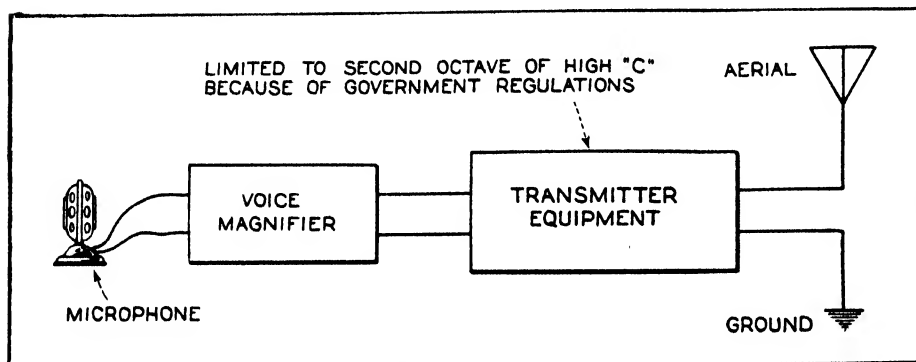
This chart serves to show the sound ranges of various musical instruments, and of the human voice. Here the third octave of high "C" has been added to the regular piano scale at the right

mately 1024 vibrations per second, otherwise quoted as having a frequency of 1024 cycles per second. The overtones and harmonics of this note, which give it its timber, would contain frequencies which would be the second, third, fourth and even higher multiples

she does on the stage of a concert hall. The loss of overtones or variations in amplitude of the fundamental and harmonic vibrations is not limited solely to the single note we quoted but is applicable to all others. Not that they are always lost but rather that

permit very satisfactory reproduction if receiving sets were so designed.

It may sound strange, however, to hear that the government limitations imposed upon broadcasting stations has an effect upon the satisfactory reception of a soprano's voice. In preceding paragraphs, we considered only two octaves when high "C" is sung. A third octave would be equal to a harmonic frequency of 8192 cycles or vibrations per second. The transmission of this frequency is prohibited by the government, since only 5000 cycle sidebands are permitted. An extension of the permissible transmitted sideband to 10,000 cycles would aid materially. At the present time, the broadcasting station would involuntarily be obliged to cut off all frequencies above 5000 cycles in the sidebands.



SIMPLIFIED SKETCH OF RADIO TRANSMITTER

The microphone converts sound waves into electrical vibrations, which are passed to the voice magnifier or amplifier. Here the fundamental and harmonic amplitudes often are changed

of 1024 vibrations. For purposes of illustration, let us assume the presence of only two octaves as harmonics. The energy distribution on the fundamental and the harmonic vibrations has no fixed law, varying with the sound produced, the characteristics of the instruments, and the person producing the sound. In some instances, the fundamental vibration has more energy than the harmonics. In other cases, one of the harmonics may have more energy than the fundamental. This should be remembered for future reference.

REFERRING again to the high "C" mentioned in the preceding paragraph, the first octave above high "C" would have a frequency of 2048 cycles or vibrations per second; the second octave would have a frequency of 4096 cycles or vibrations per second. The selection of high "C" as an illustration, is based upon a phenomenon most frequently observed. The soprano when singing in a broadcasting station sounds most disagreeable when she attempts to reach the high notes. Mind you, we say that she *sounds* disagreeable. If listened to personally in a concert hall, she would doubtless be a delight to the ear. Over the radio however, she is poor. The reason for her failure over the air is found in the loss (total) of the above harmonics in the illustration cited or in the accentuation or attenuation of either one of the two harmonics. The final result is a change in the relative amplitudes or intensities of the fundamental and harmonic frequencies. The loss of the above two harmonics when she sings high "C" would result in the loud speaker reproduction of a shrill unmusical shriek. Whenever harmonic intensities are faithfully retained, the soprano sounds as well over the air as

their loss creates the same effect. Faithful reproduction is obtained only when the fundamental and harmonic vibrations and their respective intensity amplitudes are faithfully retained.

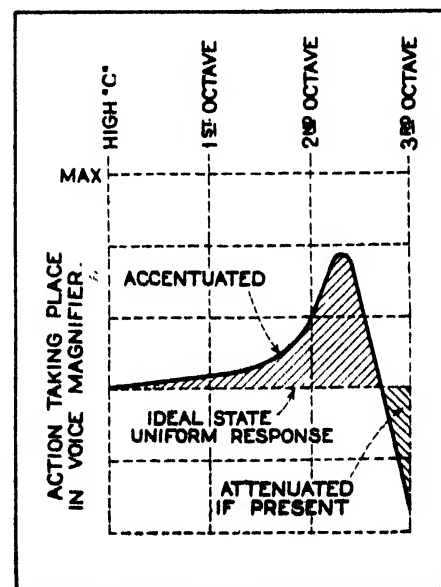
If readers will attempt to recall, a radio soprano is not disagreeable to listen to when she is singing notes within the lower half of her voice range. The reason for this is two-fold. First, her voice on these frequencies is richer in harmonics. Secondly, a greater percentage of these harmonics are reproduced with the average radio set, because their frequencies are lower. The greater richness of harmonics compensates somewhat for the partial loss of the high overtones, and even if the voice, as reproduced, does not contain all of the very high overtones and harmonics, the low overtones and harmonics which are present are sufficient to give to the reproduced tone the required sweetness and lucidity.

UNFORTUNATELY, however, the beauty of a soprano's voice is found in her ability to sing high notes. Her high notes are of high fundamental and high overtones and harmonics. Present radio equipment is not capable of faithfully retaining these high overtones and harmonics. Consequently a radio soprano's voice, when she sings high notes, will remain disagreeable until the proper changes can be made without destroying the quality of reproduction for other frequencies.

Now that we know why a soprano sounds disagreeable, let us see where the loss of overtones and harmonics occurs. An analysis of transmission systems brings to light two significant facts. First, that powerful, well-equipped and scientifically designed broadcasting stations are capable of satisfactorily transmitting a soprano's voice, that is, to such an extent as to

HENCE a change in the timber of the voice is effected at the broadcasting station. The loss of this third octave may not introduce an appreciable change, but that, in addition to what takes place in the receiver, results in the disagreeable and disparaging statements made about our radio sopranos.

The second phase to consider is the other category of broadcasting stations which do not faithfully transmit a soprano's voice. The difference between the two classes of broadcasting stations is found in the equipment which intensifies the sound waves after they have been picked up by the microphone and converted into electrical impulses. A certain amount of intensity magnification is necessary before the sound wave, now converted into an electrical wave, is propagated from the transmitting station radiating system. During the passage of these electrical impulses through the amplifying or



THE AMPLIFIER'S PART

The amplifier or magnifier in the receiver often attenuates or accentuates as shown

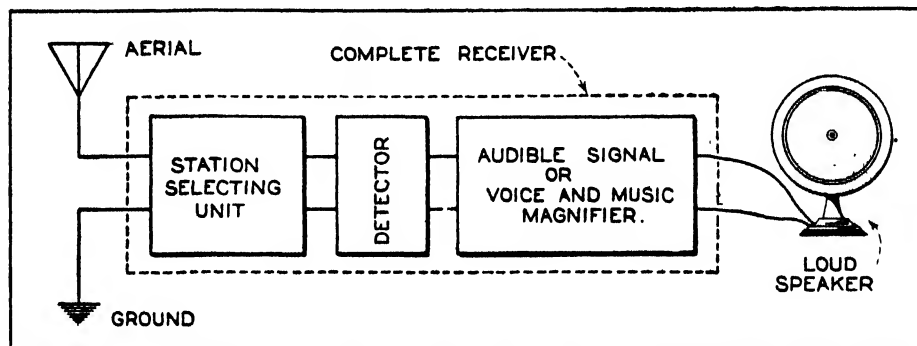
magnifying equipment possessed by the poor and mediocre stations, the relative intensity amplitudes of the fundamental and harmonic vibrations are either attenuated or accentuated with the final result that the electrical impulses transmitted to the receiving set are no longer faithful conversions of the original sound wave emitted by the singer and picked up by the microphone. Were it possible to listen to the signals transmitted from such stations, without recourse to a receiver, we would immediately note the poor response.

THE transmitting station is not the only contributor. Let us turn to the receiver. Here we must again convert the electrical impulses to sound waves. The actual process is somewhat complicated, but a description of it is not necessary for comprehension of the points at which a soprano's voice is distorted. The first source of trouble is that portion of the receiver which provides for the satisfactory selection of the station to which one desires to listen. The parts of the receiver, or the complete system of the receiver which gives it this property of station selection, produce an effect equivalent to the limitations of the aural tones which can be passed through the receiver and reproduced by the loudspeaker. This is called sideband suppression. Not that this portion of the receiver curtails the tones which the speaker will reproduce, but rather it limits the overtones and harmonics and the intensity of the overtones and harmonics which can be passed on to the other parts of the receiver and finally through the speaker.

The next factor in the receiver is the system that magnifies the aural tones which have been passed into it from the preceding system. This is the audio

amplifier. Here we find that the design of the units comprising this system is the governing factor controlling the attenuation or accentuation of overtone and harmonic vibrations passed through the amplifier. Here we find the system which, if incorrectly de-

poorly to the harmonics and overtones of high notes sung by sopranos. The speaker is the greatest contributory factor to poor reproduction of the soprano's voice. Assuming perfect transmission and perfect receiving equipment, exclusive of the speaker,



SIMPLIFIED SKETCH OF RADIO RECEIVER

In the station selector or tuner, relative amplitudes of fundamentals and harmonics often are changed. In the amplifier they are attenuated or accentuated and, in the loudspeaker, high overtones and harmonics are not reproduced. Result—poor reproduction of the soprano's voice

signed, would alter the relative intensity amplitudes or values of the fundamental and harmonic vibrations of a soprano's voice. Here we find the system which, by not properly passing or amplifying the two overtones of the illustration cited above, would greatly contribute to disagreeable reproduction.

POOR reproduction of a soprano's voice in general is greatly attributable to the operating qualities of the audio magnifying or amplifying system. Here we find that some of the units have the property of accentuating some of the vibrations which constitute the harmonics and overtones of a soprano's voice when she sings a high note. In other words, the second octave of the illustration cited might be magnified to an extent 100 percent or 150 percent greater than that existing in the original sound wave as produced by the singer. Some audio amplifying systems possess the quality of attenuating or diminishing rather than accentuating or increasing the proportion between the relative amplitudes of the fundamental and harmonic vibrations. The result is the same, namely, distortion of the singer's voice.

In all justice to the designers of radio equipment, we must qualify the preceding discussion of audio amplifiers. Many manufacturers of equipment suitable for use in audio amplifying systems have designed instruments which do not accentuate or attenuate frequencies passed through them and would not effect the soprano's voice in the manner we have discussed. The majority of receivers, however, do not employ such perfect equipment.

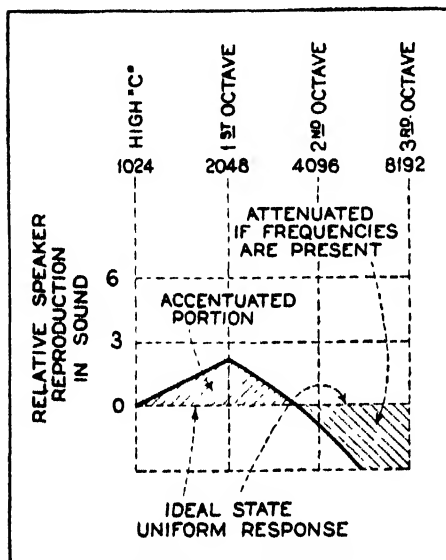
From the amplifier, we proceed to the speaker. Here we find the greatest deficiency of all because the majority of speakers respond very

poorly to the harmonics and overtones of high notes sung by sopranos. The speaker is the greatest contributory factor to poor reproduction of the soprano's voice. Assuming perfect transmission and perfect receiving equipment, exclusive of the speaker,

the latter in itself would be sufficient to cause disagreeable reproduction by lack of response to the high vibrations found in the overtones and harmonics of high notes sung by sopranos. The greatest source of trouble in what we can classify as a good receiver installation is the loudspeaker, because it lacks response on the higher audio register and because its response is far from uniform over the audio frequency band, particularly on the vibrations represented by the overtones and harmonics of a soprano's voice and by the keys on the higher portion of the treble scale of the piano.

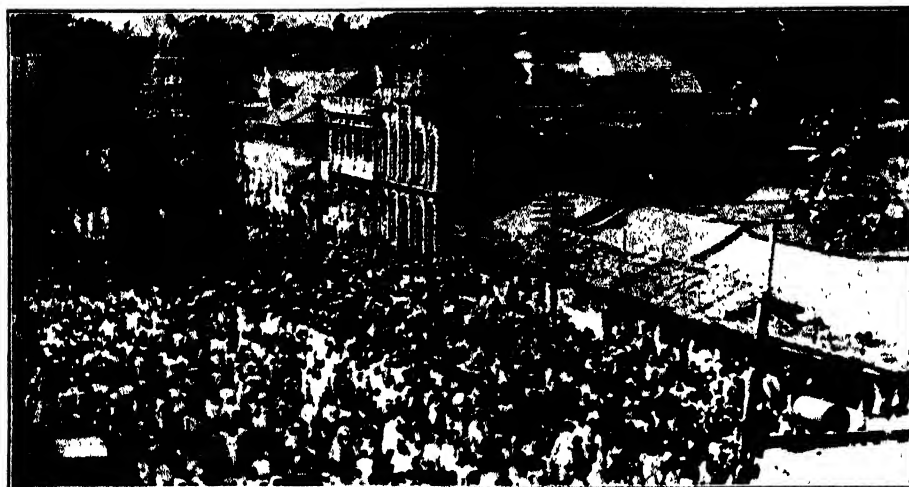
THE last but by far not the least important contributory cause for poor reproduction of soprano voices, is the general public demand for exceptional reproduction of the vibrations representing the bass portion of the piano scale and the tones produced by such instruments as the bass viol, bass tuba, bassoon, kettle drum, 'cello, and trombone, and human voices such as the bass, baritone, tenor, and contralto. The presence of the vibrations produced by these instruments and faithful retainment of amplitudes, give the richness and depth to musical reproduction and aid in the production of sounds which sound mellow to the human ear.

Unfortunately, the attainment of reproduction of the tones produced by these instruments and by these singers has thus far been carried out at a sacrifice of the higher notes and tones. Receivers have been designed for special cases and the same is true of loudspeakers when operated with certain receivers, with which excellent reproduction of the soprano's voice is possible, but on the whole, faithful reproduction of a soprano is still impossible with the average receiving set.



WHAT THE SPEAKER DOES

Chart showing how the loudspeaker changes the relative amplitudes of fundamental and harmonics by not reproducing uniformly



HORDES OF HUMANS IN OVER-CROWDED PARTS OF INDIA

A religious gathering preceding an uprising. As the famine or starvation line is approached such troubles tend strongly to become manifest. The immediate cause is not always the basic cause.

The Menace of Increasing Population

The World Is Filling Up At a Wholly Unprecedented Rate, and An Avalanche of Trouble Threatens It. What Is the Remedy?

By SIR GEORGE H. KNIBBS

Fellow of the Royal Anthropological Society; Formerly Statistician to the Commonwealth of Australia; President, Australasian Association for the Advancement of Science, and President, Royal Society of New South Wales

WHenever Nature is lavish with food supplies for her creatures, their reproductive powers cause them to attain to numbers which later occasion trouble. As soon as she becomes less lavish, many of them must perish.

In pastoral lands sheep and cattle in good seasons multiply rapidly; in times of drought they die in great numbers, and suffer greatly. Nature has no regulative arrangements for insuring that food supplies shall be adequate to meet the requirements of natural increase. Thus, in countries where human fecundity is practically unrestricted, as in Russia, China, and India, populations oscillate: in good seasons they increase; in bad times, enormous numbers perish miserably.

Civilization attempts to minimize the suffering and to avoid the needless inroad of death. Man in general, however, little realizes the true significance of his own rates of increase, or recognizes that they may point to ghastly suffering. We may well ask, therefore, at what rates has he been able to increase, and what do such rates imply?

In the United States from 1790 to

1860 the population aggregate increased at a sensibly uniform rate of about 3 percent per annum; since then, however, it has fallen off considerably. From 1921 to 1925 the people of Australia annually increased about 2.09 percent. From 1881 to 1910 some 19 countries (which have accurate statistics) increased yearly about 1.08 percent; and between 1845 and 1914 the world increase was over 0.7 percent per annum. What do such rates mean for human food supplies and for human conditions generally? That is our problem.

POPULAR imagination does not grasp the significance of rates. History goes back perhaps 10,000 years. In that time, a single pair increasing annually at the rate of one per thousand, would become only 43,833 persons; and it would take no less than 20,708 years to attain to 1,950,000,000, about the present population of the globe. To suppose the impossible, if an annual increase of one per hundred could continue for 10,000 years, the total reached would be represented by the figures 32,716,573 with 86 ciphers

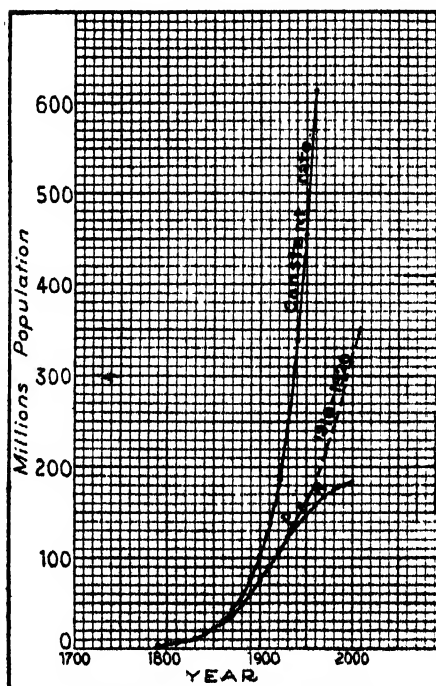
following. Some faint conception of the importance of this colossal number can be had if we remember that, were the average weight of a human being only 100 pounds, no less than 248,293,000 million million earths would be necessary to provide material for their bodies!

These illustrations enable us to see at a glance that such rates of increase as have been recently experienced by the human race, can have continued but for a short time; or else the earth must have witnessed appalling catastrophes for man from time to time.

And moreover we cannot fail to see that the existing rates are ominous for our future. Naturally, we ask, "Why is man now increasing so rapidly?" Self-evidently, a new factor has appeared. This factor is his recently acquired systematized knowledge of Nature and the development of his powers of invention.

THESE have given him a better insight into the resources of his environment and greater skill in exploiting it. He can place natural products where they can be of most service and can make them more abundant.

Man's most recondite conceptions in the realms of mathematics, physics and chemistry, have proved to be of incalculable value. He has become the creator of a new order of things. His psychological and sociological studies are making the adjustment of his various relations more easy. He has a better insight into the economic conditions of life generally, and he has gone far to correlate the various realms of his knowledge. All this has opened up new possibilities for human increase, and man has multiplied ac-



OUR FUTURE GROWTH

The sigmoid curve of Pearl and Reed (P. and R.) is the expectation of our growth.

cordingly, and "replenished the earth."

Nevertheless, this advance cannot go on, as we have already seen, without limit. The earth can carry greater numbers than in the past, because of man's progress in science and invention. But it has sharply defined limits. Various forms of life have appeared and already have passed away. Why? Answers have been attempted and from them we can see that Nature is not without conflicts of interest in respect to her creatures.

THE earth's surface is only about 197.05 million square miles. Neglecting its polar areas, its land-surface is about 52.5 million square miles. Agricultural data exist for about 46 percent of this, the corresponding population being about 41 percent of the world's total. Parceling out the whole area on the assumption that it is similar to the available data, would give, in millions of square miles, the results shown in Table I.

Arable lands are thus only about one tenth of the whole land-surface of the world. One sees at once that the available area for the effective use of human beings is, after all, very limited. In different countries the percentages of area available for cereals and food crops range between 0.1 for Tunis and

TABLE I
Division of World's Land Area
(in Millions of Square Miles)

Total	52.5
Unspecified	22.5
Non-productive	13.6
Productive	16.4
Pastures	2.8
Shrubs	0.2
Forests	7.3
Marsh	1.0
Arable	5.1
Grasses	0.79
Foods	0.39
Industrial	0.37
Seeds	0.02
Cereals	3.53

plies. A mere inspection of areas would be very misleading. The fact is that a very large portion of the earth's surface is not fitted for human occupation, nor is it usable for the growth of man's food supplies, either animal or vegetable.

In this connection it is worth noting that the total of the number of horses, cattle, sheep, goats, pigs, asses, buffaloes, camels, caribou, deer, elks, elephants, llamas, reindeer, are sensibly the same as the number of human beings. And further, that from the point of view of human food supply, they cannot be dispensed with; and, although we may make a much larger use of sea mammals, fish, and sea products generally, both for food and for general purposes, the possibilities of human increase are not substantially altered thereby.

Life in the sea world is already balanced by factors operating in that domain. Man is a land animal, and the 52.5 million square miles is his domain, only part of it being really serviceable. Later we shall again refer to the light this throws on the limit of the world's population.

RETURNING to the question of rate of increase, that which characterized the population of the United States affords one of the best possible examples of its intrinsic nature. From 1790 to 1860 its average value was 3.01577 percent per annum, from which it never deviated except slightly. The comparison of the actual numbers with those which represent a constant rate is presented in Table II.

This rate then decreased, and the extraordinary significance of that decrease is indicated by a comparison again between the actual figures and those which would have been reached had the constant rate continued. The differences, shown in Table II, are very striking.

These differences are due in part to social changes, and in part to unavoidable difficulties in exploiting one's physical environment. It is worthy of note that the constant rate of the table

would have given by the year 2000 a greater population for the United States alone than the whole world at present contains!

To continue the comparison further, we give in Table III not only the numbers but also the corresponding densities in persons per square mile, taking the area of the United States as 3,026,789 square miles. We see that were it possible for the rate from 1790 to 1860 to continue to the year 2000, the United States would be peopled nearly as densely as England and Wales are today, the density there being 670 per square mile. Professor Raymond Pearl and Dr. L. J. Reed, on certain assumptions, estimate that the United States cannot carry more than 65.176 per square mile, a density which it would have already by far exceeded.

By changes in the standard of living, however, by improvements in the food supply, and by better economics generally, the density of 65 per square mile can greatly be exceeded, but the figures for year 2000 and later are, of course, hopelessly impossible.

WE pass on now to consider the existing position for the whole world. It has already been noted that from 1881 to 1910, 19 countries increased at the rate of 1.08 percent. From 1906 to 1911, 26 countries increased at the rate of 1.16 percent. Obviously we may take an annual increase from 100 to 101 as an appropriate basic assumption for a study of the world's increase in the immediate future. We have already seen that it cannot last for many centuries. Starting with say 1950 millions in year 1928 we get the results shown in Table IV.

Thus we see that by the year 2100 the world's population would be more than five and a half times what it is now, if the rate of 1 percent increase annually could be maintained.

It may bring the matter into more direct touch with one's imagination, if we turn back to the rate of growth of the United States population from 1910 to 1920, viz. 1.402 percent per annum, or 14.938 percent per decennium. In the middle column of Table V the figures in millions for this rate of progression are given; in the right hand

TABLE II
Comparison of U. S. Population
Increase in Millions With
the Constant Rate

Year	Actual Number	Rate Constant
1790	3.929	3.929
1800	5.31	5.29
1810	7.24	7.12
1820	9.64	9.58
1830	12.87	12.89
1840	17.07	17.36
1850	23.19	23.36
1860	31.443	31.443
1870	38.56	42.32
1880	50.16	56.93
1890	62.95	76.67
1900	76.00	103.20
1910	91.97	138.90
1920	105.71	186.95
2000	?	2013.76

43.1 for Czecho-Slovakia; and for the whole world may perhaps be taken as under 8 percent. The productivity of the various areas differs as much as seven times. Thus Russia in Asia produces 7.0 bushels of wheat per acre; Tunis 7.1; while Denmark produces 51.0; and the Netherlands 49.2. The world average is probably slightly over 14 bushels of wheat per acre, viz. the rate of yield of Spain, Jugo-Slavia, Australia, and Canada, (1921). The United States yield is slightly lower.

Facts such as these remind us that something more than a mere survey of areas is necessary to ascertain the possibilities of the world's food sup-

TABLE III
Persons per Square Mile Forecast
for United States at Present
Rate of Increase

Year	Constant Rate	Density
1920	187	62
1950	456	151
2000	2014	665
2050	8896	2939
2100	39296	12983
2150	173591	57531
2200	766830	253348

TABLE IV
Future Population of World
1 percent increase per year

1928.....	1950 millions
1930.....	1989 millions
1940.....	2197 millions
1950.....	2427 millions
1960.....	2681 millions
1970.....	2962 millions
1980.....	3271 millions
1990.....	3614 millions
2000.....	3992 millions
2050.....	6565 millions
2100.....	10797 millions

column the figures are as given by the theory of Professor Pearl and Dr. Reed.

These final figures are based on the view that 197,274,000 is the greatest population the United States can ever carry, and that the rate of increase is always proportional to the defect from this, divided by this number. Such a result, however, indicates that the United States can never on the average be populated to one tenth of the density actually now existing in England and Wales and in Belgium, where the densities are respectively 670 and 665 per square mile, while the limit for the United States would be only 65.18.

EVEN if the constant annual rate of 1.402 percent could be maintained, the density for the year 2000 would be only 106.38 per square mile. The dotted line on Figure 1 illustrates the numbers which would be reached if the rate from 1910 to 1920 were to continue.

A survey of the rates of growth in various countries, taking also into account their natural possibilities, shows that some can greatly increase their populations as soon as the necessary conditions are realized. This fact suggests that excessive densities of population might well be relieved by appropriate migrations. The actual population-carrying power of different regions, however, differs enormously, and although it is not revealed directly by existing population densities, it is to some extent indicated thereby, especially if we take large areas into account. Refer to Table VI.

The geographical irregularity of these densities is worthy of notice, as is also the character of the civilization prevailing, and of the forms of government of the various countries. Density of population is dependent, not merely upon the natural wealth of the territory inhabited, but also upon the intelligence and technical knowledge of the inhabitants, their character and thrift, their standard of living, their social economics, their relations with other peoples, their political outlook and aspiration; in short, upon their character and culture.

Recent accessions of scientific knowledge, and better grasp of the possi-

bilities of its applications to man's needs, as well as skill in invention, have expressed themselves in an increase of his food supply, and have thus brought about corresponding increases in the numbers occupying particular territories.

Countries like Germany and Japan, however, are not living solely upon their own food productions; they must perforce exchange the products of their secondary industries in order to make good the shortage in their own production of food-stuffs. When this is taken into account, the question of the futures of territorial densities of population becomes more complex.

The fact that nations are not living in assured peace and that they are variously circumstanced in regard to the

TABLE V
Future Population of the United States. Comparison of Constant Rate with Theory of Prof. Pearl and Dr. Reed, in Millions

Year	Increase Constant	Pearl-Reed Theory
1930	121.5	122.4
1940	189.7	136.3
1950	160.5	148.7
1960	184.5	159.2
1970	212.1	167.9
1980	243.7	174.9
1990	280.1	180.4
2000	322.0	184.7

production of the necessities of life, has to some extent forced upon them the insuring of that measure of trade and commerce without which they cannot maintain their peoples in good condition. Professor E. M. East in "Mankind at the Crossroads" has dealt with this aspect of the question sufficiently to show that with increases of population we are moving toward more and more critical situations. Studies, like those of Mr. O. E. Baker of the Agricultural Economics section of the United States Department of Agriculture, afford also an indication that for the United States, for example, the outlook is disquieting for the future, if it be hoped to maintain the present standards of living.

WE have already seen that to keep up the rate of population increase reached between 1910 and 1920, we should have to make the increase of food-stuffs in 1980, say, double what they would be in 1930 (see Table IV). Or, what amounts to the same thing, population and its requirements would double every 49.786 years. In, say, about 250 years, the 105,711 millions of the United States in 1920 would reach no less than 3383 millions. It is these considerations that have compelled the recognition of the fact that increases of populations increase the

difficulties of growing at the same rate.

"Can migrations greatly diminish difficulties arising from the over-rapid growth of populations?" is a question now presenting itself to the world-mind. Obviously, were there no intrinsic difficulties, they could temporarily alleviate the situation.

But there are difficulties. Differences of color and physique, of standards of living, of political and social outlook, of prevailing hygiene, of language, and of average wealth, all hinder migration.

MANKIND is very far from a homogeneity for the purposes of intermixture. Moreover, successful migration often demands that migrants shall be specially endowed as regards intelligence, courage, and pertinacity. Not infrequently they must have a modicum of capital to succeed. The occupants of a territory are not prepared to welcome the derelicts of other countries. Often other countries will not lose willingly their better and thriftier citizens who wish also to carry away some of the countries' wealth.

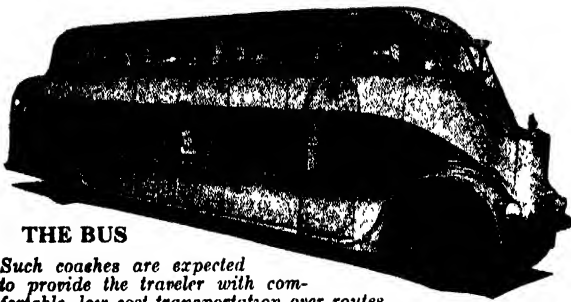
Another factor of importance is that the power to absorb migrants is very varied. Enormous areas in South America, in Africa, in Russia, in Asia, and in Australia could be peopled, were the conditions for absorption really suitable. But they are not so at present, and the absorbing countries would be involved in considerable outlay in taking in immigrants. One need only

(Please turn to page 377)

TABLE VI
Population Density of Entire World

Division or Country	Persons per Square Mile
Continents	
Europe	127.6
Asia	65.2
Africa	10.6
North and Central America	17.5
South America	9.5
Australasia and Oceania	2.7
Countries of over 100,000,000	
British India	226
China	109
Russia	75
United States	39
Countries of over 50,000,000	
Germany	347
Japan	320
Feud. Ind. States, Asia	101
Neth. E. Indies	89
Countries of over 10,000,000	
England and Wales	670
Italy	339
Czecho-Slovakia	265
Poland	195
France	192
Rumania	142
Jugo-Slavia	125
Philippines	99
Nigeria	59
Egypt	37
Abyssinia	29
Turkey	25
Persia	19
Mexico	19
Brazil	9.3

Motor Sleeping Coach



THE BUS

Such coaches are expected to provide the traveler with comfortable, low cost transportation over routes and through districts hitherto unprovided with such service. This coach carries 26 passengers and their luggage.

A 13-COMPARTMENT automobile bus, a veritable motor-Pullman having a sleeper capacity of 26 persons on two decks, has just been built by a large stage company of Los Angeles. The company will use it on the San Diego-San Francisco route. Additional similar buses will eventually extend this service to Vancouver, Canada, and across the country to east-coast cities.

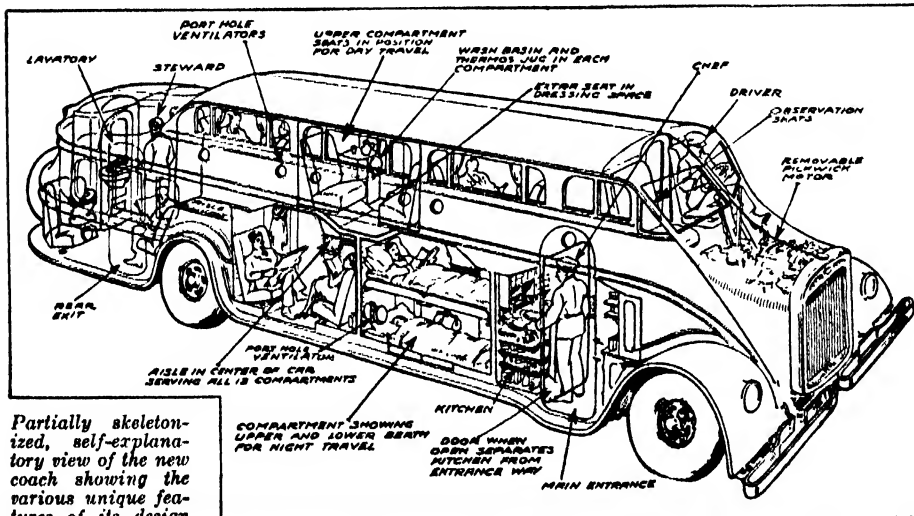
The body of this bus, the unique design of which may be seen from the illustrations, is made of duralumin so that the total weight is only 14,000 pounds. It is 34 feet six inches long, eight feet wide, 10 feet three inches high, and cost nearly 30,000 dollars. Every compartment



P and A

THE REMOVABLE MOTOR UNIT

The bus has no hood, so the motor is withdrawn horizontally on a carriage after bolts, gasoline and oil feed lines, and the electric lines, are disconnected



Partially skeletonized, self-explanatory view of the new coach showing the various unique features of its design

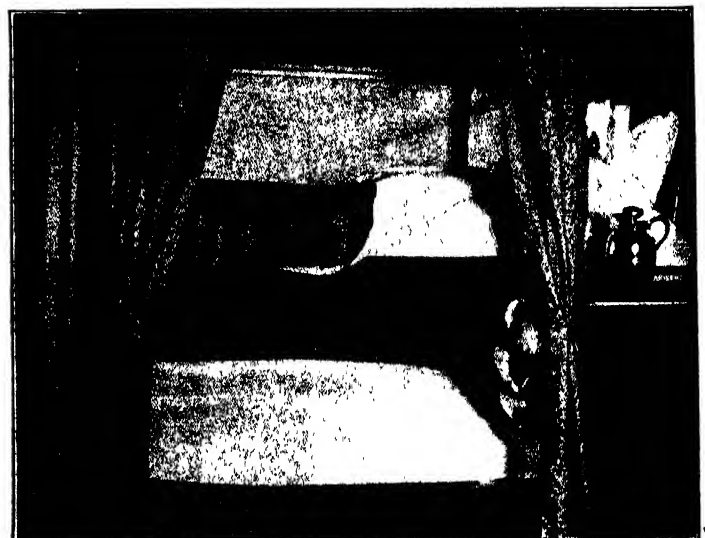
has running water, a wash basin, two berths, windows, electric fans and lights, thermos bottle, et cetera, and is six feet four inches from floor to ceiling. A center aisle, located halfway between the upper and lower decks, leads to a lavatory in the rear. The space inside the front door is used as a kitchen when the door is closed. This kitchen is equipped with an electric stove, toaster, coffee urn, and an ice box.

A remarkable feature of the design is the manner in which the 110 horsepower motor may be removed. Spare motors will be stored at all stations along the route, and a new motor may be installed in 20 minutes by loosening the oil, gas, and electric lines and a few bolts. The crew consists of a driver, a chef, and a porter.



COMPARTMENT DURING THE DAY

Seating arrangement of a two-person compartment. Just inside the door at the right is shown the basin which turns upward on a hinge



BEDS PREPARED FOR THE NIGHT

Heavy sliding curtains give privacy to each compartment at night. Besides other equipment, each has space for luggage and for the clothes



NISQUALLY GLACIER, MOUNT RAINIER

Visitors in rapidly increasing numbers are taking advantage of the winter sports and the opportunity to climb real, "live" glaciers afforded by this snow-clad mountain that rivals the Alps

Up Snow-clad Peaks

Climbing a Mountain of the Rockies

Where Glaciers Are Plentiful

By HERBERT OTIS WARREN

MOUNT RAINIER, in the western part of the state of Washington, lies about 40 miles south-west of Tacoma, and forms part of the great Pacific Coast drainage system. With 48 square miles of glaciers, an expanse of ice far exceeding that of any other single peak in the United States, Rainier even surpasses in magnitude and splendor some of the famed glaciers of Switzerland. Soaring 14,408 feet into the air, the gigantic proportions of the peak seem to dwarf mountains more than 6000 feet in height around the base—and the eminence covers 100 square miles of territory, or one third of the area of the Rainier National Park.

Mount Rainier is now an extinct volcano. Indian legends tell of a great eruption many years ago, but on record there actually are four noteworthy outbursts—one in the year 1843, one in 1854, one in 1858, and the last in 1870. There is no danger of another outburst, according to the United States Geological Survey, but there is evidence of hot springs at the foot of the mountain and there are also jets of steam near the summit which melt holes in the snow and ice.

The life history of Mount Rainier has been a varied one. Like all volcanoes,

it has built up its cone with the materials ejected by its own eruptions—with cinders, steam-shredded particles, lumps of lava, and with occasional flows of liquid lava that have solidified into layers of hard, basaltic rock. The steep inclination of the lava and cinder layers visible in its flanks has led geologists to believe that at one time the mountain must have approached a height of 16,000 feet—an explosion that followed reducing the height by some 2000 feet to its present measurement. Two small cinder cones later filled this cavity, which measured nearly three miles across from north to south. Ensuing eruptions gradually added to the height of the cones until finally a low rounded dome was formed, this being the present summit.

EXTENDING from the summit there are great ice streams, four to six miles in length, cascading into the rivers below. Six massive glaciers appear to originate from the very summit: the Nisqually, the Ingraham, the Emmons, the Winthrop, the Tahoma, and the Kautz glaciers. Such glaciers as the Cowlitz, the Pyramid, and the Paradise, while of enormous size, are born of snows in rock pockets or *cirques*—deep bowls sculptured from the ice—and finally merge into the glistening armor of the volcano.

In all there are 28 glaciers on Mount Rainier, seven of them being "live," or moving, glaciers which originate in the summit snows and move down its slopes in their separate canyons, at the rate of from 16 to 20 inches a day.

Through 14 valleys these rivers of ice flow in paths self-carved. Just as water flows, these ice packed masses



AN ICE CAVE IN PARADISE GLACIER

Hot springs, jets of steam, and warm air currents, singly or together, melt huge caverns under the ice. In the foreground will be noted a rushing icy stream which helps to keep this cave open

turn and twist on their downward path, avoiding the harder rock strata, until they reach the lower altitudes where the warmth turns them into rivers of water.

The ascent of Mount Rainier is usually made from Paradise Valley, over the Gibraltar route, and should be taken under the leadership of a competent guide. Before the start, the necessary equipment for the long hike, such as alpenstocks, amber glasses, hobnails and calks for boots, khaki breeches, et cetera, can be secured at nominal rental fees. Actor's face paint is also necessary to protect the face from sunburn.

THE party leaves the valley in the afternoon in order to reach Camp Muir before dark. Here, the Government has erected a stone shelter cabin which protects the climber from storm and wind. With blankets also provided, a good night's rest may be had before continuing the climb early next morning.

Cowlitz Cleaver, a narrow spur of rock, is a difficult ascent and it is not until about eight o'clock that the base of Gibraltar Rock is reached. The way now leads over a narrow ledge on the face of the cliff, part of the way overhung by icicles and rock masses. This tiny ledge leads to the base of a narrow chute between the ice of the upper Nisqually Glacier and the body of Gibraltar. By aid of ropes suspended



NEAR THE SUMMIT

Climbers with guides ascending Mount Rainier. The ladder used is carried along in sections that are easily joined together

from the cliffs this arduous passage is made, one person climbing upward at a time to avoid slides of ice and rock debris. Gibraltar, 12,679 feet high, is reached about 10 o'clock, and there

now remains a long snow slope to climb. One hour later, the rim of the south crater is reached. This rim is always bare of snow, but the crater itself is perpetually snow-filled. It may be traversed without risk if the edge is not approached, for the snow is there melted out in caverns by the steam jets. Columbia Crest, the pinnacle of the peak, is just beyond, but out of a party of say, 20 climbers, perhaps 15 will be able to make the final climb, the rest being too exhausted to accomplish the strenuous task. As a usual thing, tourists are content to explore the ice caves and climb the smaller peaks.

THERE are certain well-known rules of mountaineers which, when adhered to, make the ascent of Mount Rainier comparatively easy. First of all the over-ambitious should curb their desire to start immediately for the summit; they should first practice on the shorter hikes, and in this way become accustomed to the higher altitude and toughen their muscles for the longer climb. Moderation in diet and the avoidance of heavy food of all kinds are precautions that cannot be too strongly recommended for those attempting to make the ascent.

Perhaps you've never heard of the plant whose seeds bore their way into the earth like a brace and bit. Then you will be interested in the coming article describing this marvel of nature.



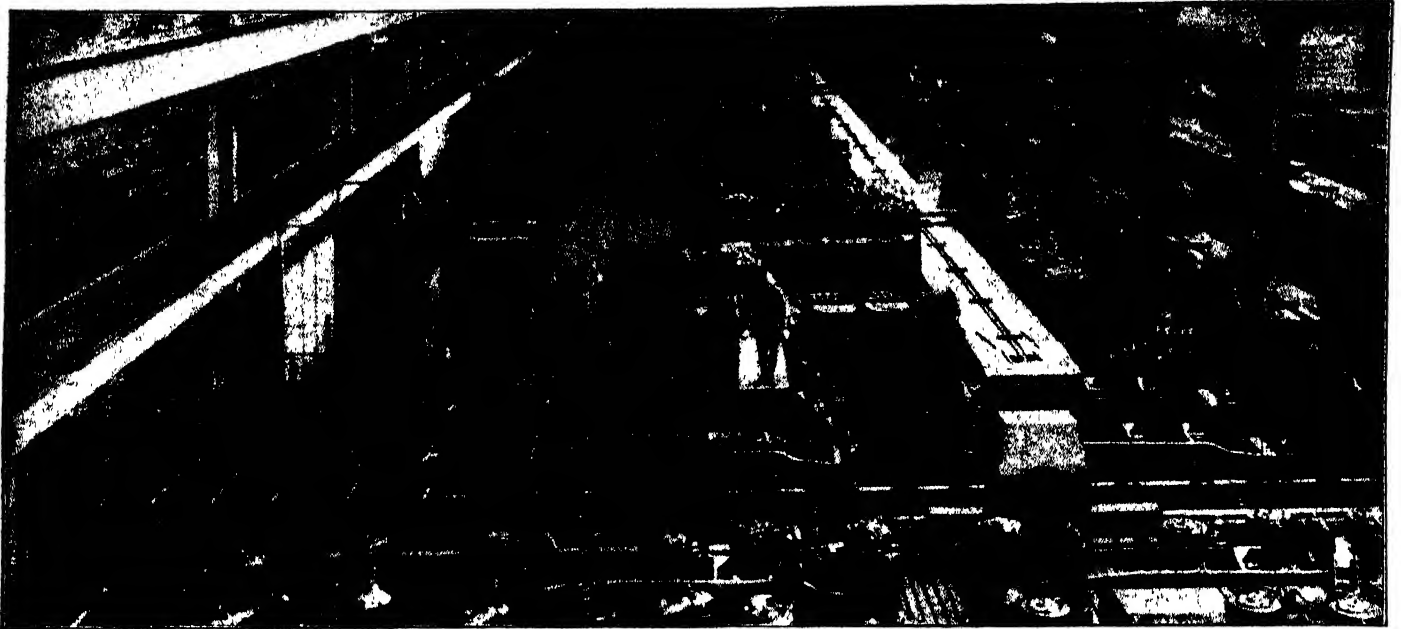
A DANGEROUS GLACIAL CREVASSE

A party on Nisqually Glacier, 45 minutes walk from Paradise Inn. Parties visiting the glaciers are under the direction of competent guides



TUMBLING HEAPS OF ICE

A hike of an hour brings the climbing party to scenes such as this. All are equipped with alpenstocks, darkened glasses, and warm clothes



THE FINAL ASSEMBLY

Various machining operations are carried out on the left side and right side members as they come from the rear on parallel conveyors, together with the cross bars. These sub-assemblies transfer to the transverse machine in the foreground where they are clamped together and riveted

One Machine Fills a Huge Plant

Greatest Automatic Machine in the Automotive Industry Receives and Inspects Strip Steel and Turns Out Completed Frames Almost Untouched by Human Hands

CHARACTERIZED as one of the most romantic accomplishments of the modern industrial era, the plant of the A. O. Smith Corporation for making automobile frames is virtually one huge automatic machine which receives and inspects strip steel and manufactures a completed enameled frame in less than two hours.

Except for minor operations such as pickling, cleaning, and oiling the stock, and inspecting the assembled frame, the automatic machine takes care of all operations and the unit being manufactured is not touched by human hands, each frame remaining on conveyors 90 percent of the time. There are 552 operations on each frame, and since the plant has a capacity of 7000 frames daily, the daily operations performed by the machinery total 4,000,000. The plant is 600 feet by 212 feet.

THE first unit in the manufacturing line is the inspection machine. This machine automatically rolls the strip steel to remove curvature, measures it for thickness, length, and width, and automatically stacks it in piles. Rejections are thrown aside in a separate pile.

A monorail crane then carries the steel to the pickling department which consists of crates made of acid-resisting

metal, each of which has a capacity of about five tons. These crates pass through the acid and alkali tanks and then through the oil tanks to give a protecting coat of oil.

From this point the steel is automatically carried to the side bar manu-

facturing line where the sequence of operations is: (1) offsetting strips for vertical bends in the frame; (2) piercing left hand strips; (3) piercing right hand strips; (4) blanking both sides; (5) forming the left hand blanks; and (6) forming the right hand blanks.



STARTING THE SIDE BARS

Here the strip steel is blanked, pierced, formed, and offset to give what is called the "kick-off" over the rear axle and the front and rear drops. There are six of these presses at starting end

The left hand and right hand members are offset alike and are carried along the line to the piercing presses. Locating notches to secure accurate registering in the blanking presses are also made on the piercing presses.

After the side members have passed through the blanking machine, they are carried down the conveyor and transferred to the forming press which forms first the left hand and then the right hand members by means of fingers which are almost human in their action.

All side members are then transferred to the side-member assembling line. Here they are loaded automatically in pairs on trucks which are carried by a reciprocating conveyor down the line. This line, approximately 400 feet long, stops at 19 stations, at each of which several machines are at work pinning and riveting brackets in place to complete the side member sub-assemblies.

SINCE side members are handled in pairs and the cross members individually, four manufacturing lines, each with a capacity of 450 cross members per hour, are necessary to keep step with the two side member lines.

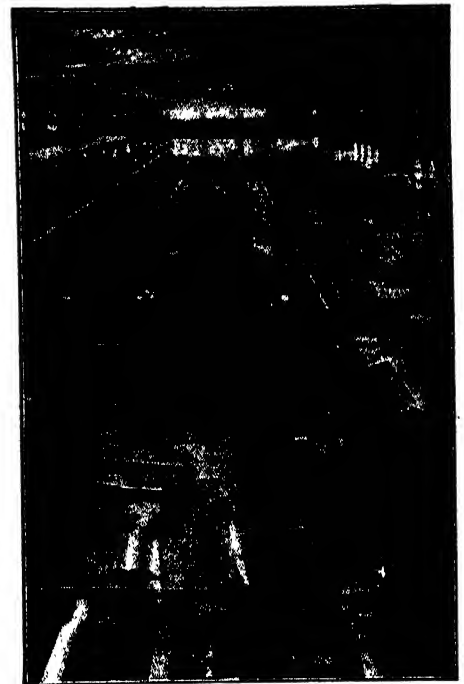
In the four lines which fabricate the cross members there are blanking presses which also pierce holes, drawing presses which form the end laps as well as the channel or other section as required, automatic drilling machines, and riveting presses.

When the side and cross members have been fabricated they are carried by conveyors to the final assembly line. Here they are picked up automatically, fastened together in proper relationship to each other, and automatically riveted. The rivets used in this operation are fed into tubes below the assembly lines and carried by compressed air to the riveting guns. Approximately 90 rivets are placed in about 10 seconds, the final heading being done on another machine

equipped with jaws variously shaped to operate in any position desired.

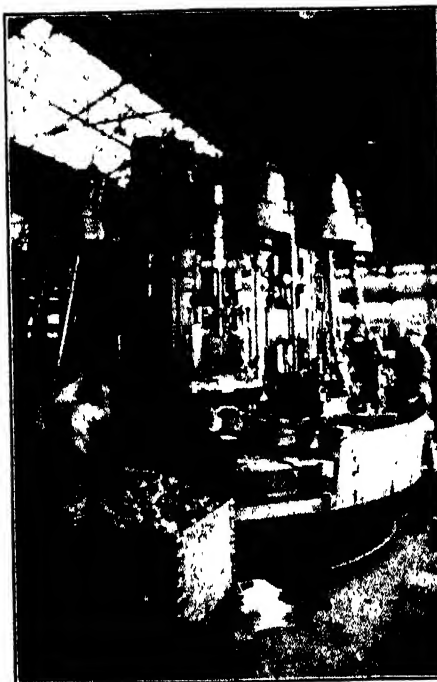
At this point the assembled frame is checked by inspectors for alignment and proper location of the various holes and locating points. Following the inspection, the frames go to the automatic washing and enameling unit. Here they are cleaned, dried, and then discharged by gravity to the loading station of the painting machine where they are coated with a high-temperature baking enamel. A conveyor chain, about 700 feet long, carries the frames through a two-story oven in which they are baked for one hour.

The one link remaining is that of storage. Since shipping schedules could not possibly be arranged to move continuously the enormous production



THE 19-STATION LINE

Various machining operations for side members are performed on these parallel ways. Assembly is completed at the far end

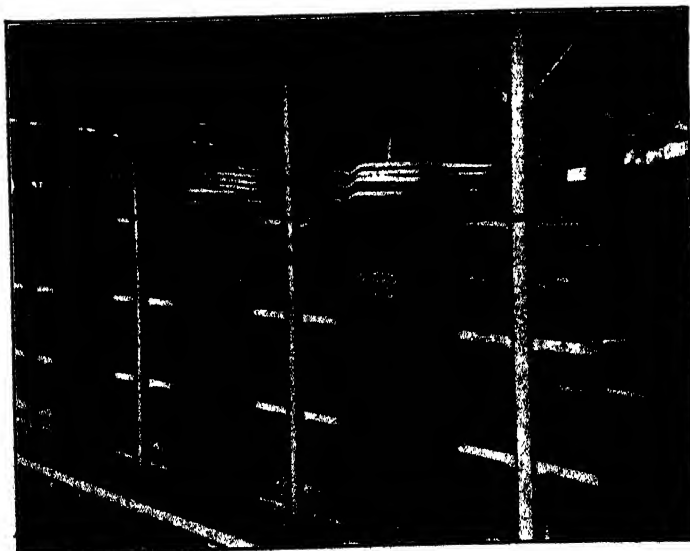


SPRING-HANGER MACHINE

Special machines for making small parts are distributed along the sub-assembly line

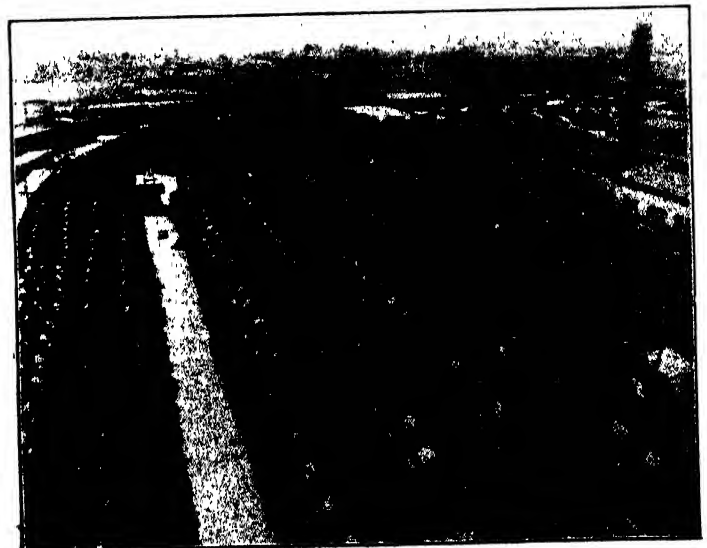
of this plant, adequate storage space is necessary. Therefore the plant is equipped with a storage house 335 feet by 216 feet. In this building monorail crane systems are provided on two levels to transfer bundles of frames to the racks specially designed for this purpose. Besides the indoor storage there is a supplementary storage yard outside the building which is served by means of swinging cranes.

Besides being spectacular in its performance, this plant is said to be a commercial success. It is said that the number of men employed to supervise the automatic equipment—about 200—is less than one fifth the number necessary for a semi-automatic plant having an equal production capacity.



STORAGE BUILDING

At the upper right may be seen the traveling monorail crane which can be run over any aisle to deposit frames on the extended brackets



STORAGE YARD

Outdoor storage of frames ready for shipment. A vast amount of space is necessary to store temporarily the large production of this plant

Inventions for the Household

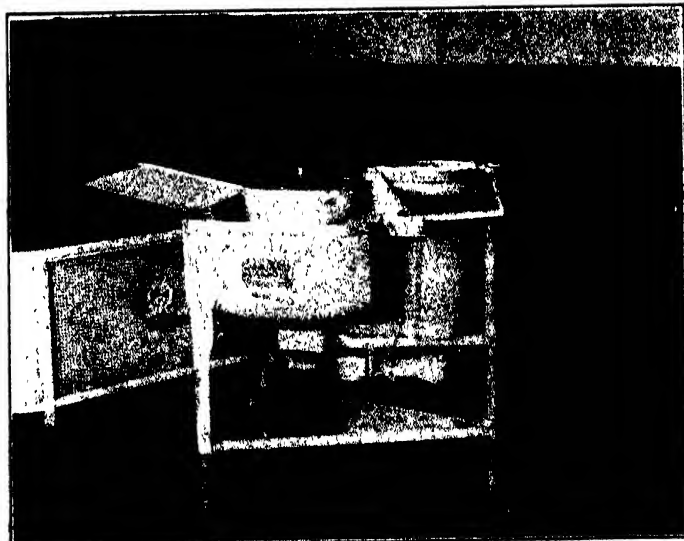
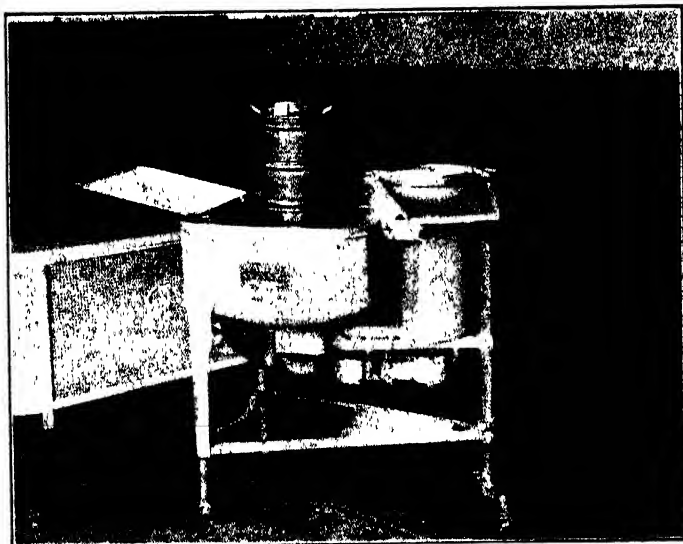


SALT AND PEPPER SHAKER

This duplex salt and pepper shaker of glass has a sliding top which normally covers both salt and pepper but can be slid over to the left or right to expose either.—*Better Sales Company, 112 Market St., San Francisco*

◀ INDOOR FOLDING CLOTHES RACK ▶

A floor area of only 20 by 36 inches is equivalent to 75 feet of drying space when this folding rack is used. When folded, it takes up no more room than an ironing board. It weighs only 15 pounds, but is large enough for the largest sheet. Clothes hang over wooden rods so they will not be line-marked or otherwise soiled. Useful in apartments away from outdoors grime.—*Handy-Ann Co., Portland, Ore.*



ICE CREAM FREEZER AND CHURN

The two photographs at the left show a new freezer designed to operate in a washing machine. The illustrations at the right show a churn that is similarly operated. (Freezer and churn are shown in two different types of washing machine.) In the freezer, an adjustable friction disk in the top cross-arm holds the dasher in place while the can turns on a bronze shaft that extends up through the ice chamber. This shaft is connected to the center post of the washing machine. An outside can surrounds the ice chamber and catches the overflow; no salt water can come in contact with the washing machine. The churn has a post in the center which fits down over the center post of the washing machine. Its operation is similar to that of the freezer. City dwellers can always have fresh butter by buying whole milk and churning it themselves.—*Cole Manufacturing Company, Birmingham, Ala.*

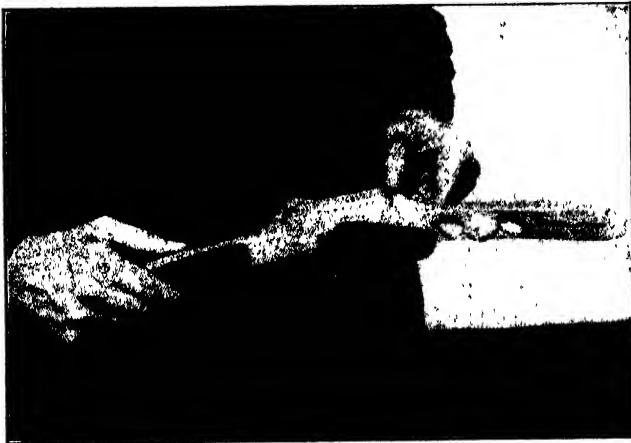
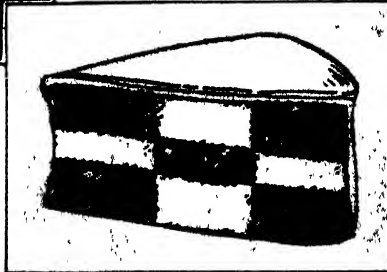


**POTTED PLANT PLATE >**

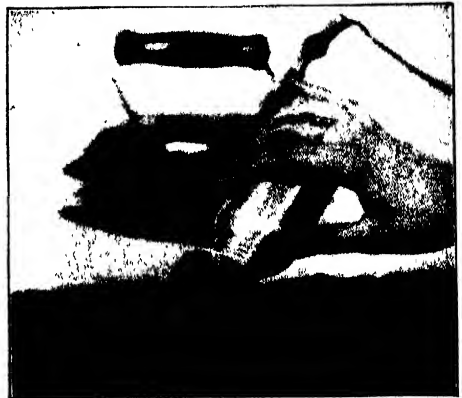
This new plate for holding potted plants is made of semi-rigid rubber. Pots may thus be placed on the library table or other finely finished surface without danger of scarring the paint. It is large enough to hold any excess water that may drain through the soil, and is not unattractive.—*Lewis and Conger, 45th St. at Sixth Ave., New York*

**UNIQUE CAKE PAN >**

To make a cake like the checkerboard slice at the right, drop the center section, consisting of two concentric rings, into the large pan; pour different colored cake batter into the three rings; and bake in usual way. Arrange the layers properly and you have it.—*Lewis and Conger, 45th St. at Sixth Ave., New York*

**<CLOTHES HANGER**

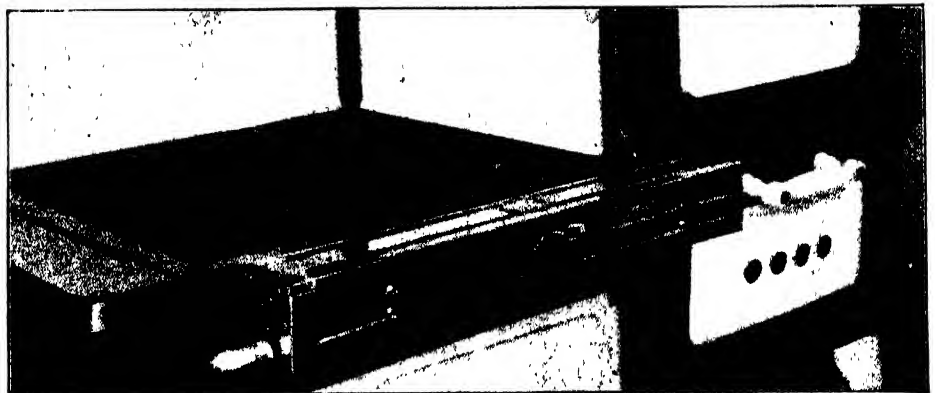
The distinctive feature of this new clothes hanger from France is that it carries its own protection against moths. Underneath each arm a recess is cut to receive moth balls in a special flat wafer shape. Over each of these there is a perforated metal guard which swings open for inserting fresh wafers and snaps tightly closed.—*Lewis and Conger, 45th St. at Sixth Ave., New York*

**CLOTHES SPRINKLER**

This simple device is almost an instance of the turning of swords into ploughshares for it is being made in Germany with the same machinery used during the war to make shells. Made of thin aluminum, it holds about a pint of water.—*Lewis and Conger, 45th St. at Sixth Ave., New York*

**TABLE ELECTRIC FAN**

Attractive as well as practical, this new fan represents a radical departure from existing standards. The fan turns in a horizontal plane, well protected by the filigree guard, and throws a current of air upward against the deflector which, in turn, throws it outward without creating a direct draft. The top may be used as a container for fruits, flowers, or any variety of ornaments.—*Electro-Dental Manufacturing Co., Philadelphia, Pennsylvania*

**GAS RANGE LOCK >**

In a home where there are children, this lock is almost a necessity. The gas cocks are enclosed in a metal housing which is easily manipulated but which eliminates the danger of accidental opening of the cocks by children or a loose apron string.—*Rolland and Neubarth, 202 Barton St., Flint, Mich.*

CORK-BACK BRUSH >

The bristles of this brush are mounted in a solid piece of cork. It will float on top of the water and the back will not crack from constant soaking. For this reason, it should outwear some wooden brushes.—*Marshall Field Co., Chicago*



Inventions New and Interesting



ALL METAL GUITARS

The instruments shown here are made of 22 gage German silver and use a new principle of sound production. Contrary to the popular belief that two resonators will resonate more than one, two of the circular amplifiers are placed on the treble side and only one on the bass side when the bass tones are to be emphasized.—*Sherman Clay and Company, 536 Mission St., San Francisco*



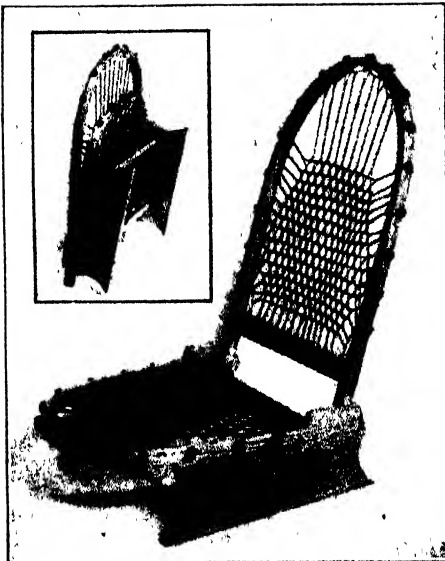
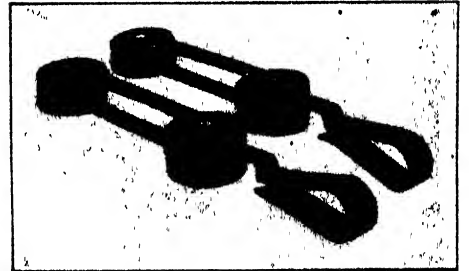
MARCEL WAVER

With this iron, models of which are made to be heated electrically or on a stove, marcel waves are made by a lever attachment that pushes forward or backward in the groove to curve the wave to front or rear.—*The Marcel Waver Company, Los Angeles*



TYPEWRITER ANCHOR, SILENCER, AND SHOCK ABSORBER

A new clamp which, when fastened to the typewriter with two screws, allows quick transfer of the machine to other desks yet always anchors it securely. At the left is shown a typewriter held in place by two of these clamps and at the right is a close-up.—*The Lin-May Company, 111 W. Jackson Boulevard, Chicago*



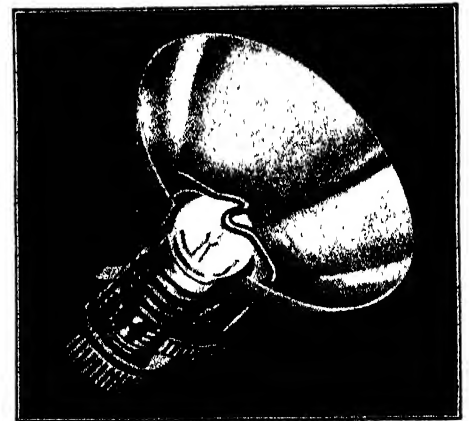
RACKET CHAIR

Embodying the principle of snowshoe manufacture, this canoe chair was designed by a Maine woods guide. It weighs four and a half pounds and is made of white ash, spruce, and selected rawhide.—*Kabin-Kraft, Service, Augusta, Maine*



PIPE CLEANER

This nickel-plated cleaner resembles a fountain pen and may be carried in the pocket. A spiral wire, which is extended by a sliding button, cleans any stem, curved or straight. A heavier rod cleans the bowl.—*Costick Products Co., 400 W. 23rd St., New York*



MINER'S SAFE FLASHLIGHT

The lamp holding mechanism of a flashlight designed to prevent explosions when a lamp shatters in an atmosphere of gas. When the bulb breaks, base is hurled out, and current is cut off.—*National Carbon Co., Inc., 30 E. 42nd St., New York*



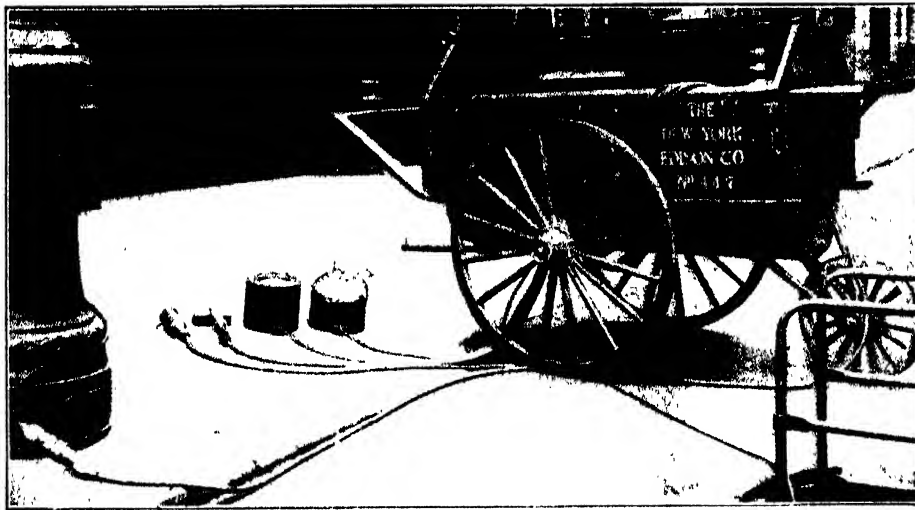
◀ MASSAGING MACHINE

The four soft rubber pads of this device are agitated by a small electric motor, their movement being such as to thoroughly knead the scalp, induce better circulation, make the scalp healthy and promote hair growth.—*Blud-Rub Mfg. Co., 730 E Washington St., Indianapolis, Ind.*



▲ HANDY LABEL ROLL

This helpful little device consists of a conveniently shaped, hand fitting metal container, filled with a roll of gummed tape. A slight thumb movement slides the tape out perfectly flat, a metal edge being provided for detaching sections.—*Handy Roll Co., Fruitvale, Oakland, Cal.*



▲ ELECTRICITY USED IN CABLE SPLICING

Here are shown a solder pot, compound kettle, soldering iron, and portable lamp—all electrically operated—ready for use in splicing cables in manholes.—*New York Edison Co., 130 East 15th St., New York*



CHILD'S SUN-BATH SUIT

This photograph shows one of a number of styles in summer clothing for small children that have been designed by the Bureau of Home Economics, Department of Agriculture, and announced in a recent bulletin. Besides being loose and comfortable, these suits allow penetration of the beneficial sun rays. Bulletin is sold by: *Superintendent of Documents, Washington, D. C.*



FERTILIZER SPREADER

This spreader has been designed to make possible the even spreading of fertilizer, lime, or gypsum over the lawn. It removes the danger of burned-out grass due to uneven spreading by hand. For spreading fertilizer or sowing grass seed, the device is operated like a lawn roller.—*Standard Equipment Co., 965 Second Ave., W., Cedar Rapids, Iowa*



EXPLODING TIMBER-SPLITTING WEDGE

Black powder is first poured into the chamber in the wedge blade; the wedge is then driven into the timber; the fuse is lighted; and the explosion that results, blows the log apart.—*Hutchinson Mfg. Co., 7721 Susquehanna St., Pittsburgh, Penna.*

The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

Lincoln Highway Signed with Concrete Posts

DURING the past summer, the Lincoln Highway, stretching from east to west across the country, was re-marked by concrete posts of an entirely new and unique design. On the side of these posts facing the motorist, there appears an arrow, cast of blue concrete, directing the driver to proceed straight ahead or turn to the left or right.

On the face of these markers, there are the familiar Lincoln Highway red, white, and blue bars, each being cast in colored concrete, while above this there is a bronze medallion of Lincoln set into the concrete. This medallion, which is four inches in diameter and somewhat similar to a coin in arrangement, bears the inscription: "This highway dedicated to Abraham Lincoln."

The plan to mark the highway in this manner has been under consideration for several years, but the initial cost prevented until two sponsors of the Lincoln Highway—Willys-Overland and General Motors—both of whom have contributed to road building in the far west, offered to finance this new venture. It is believed such markers will eventually supplant present methods, all of which require a heavy expense in maintenance.

The Lincoln Highway posts, being made of two imperishable substances, concrete and bronze, are expected to last indefinitely and will require no maintenance.

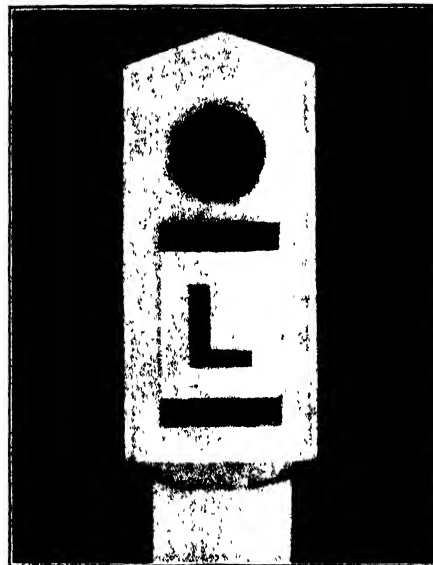
Locomotive Has Front End Cab

MANY horses win races only because their shoes have the right shape and weight. Railroads have found that some of their "iron horses" can win the race against large operating costs by making a few changes in the construction of their locomotives.

The Southern Pacific, which maintains at Sacramento, California, one of the largest railroad shops west of the Mississippi, recently re-modeled one of its locomotives in order to improve its efficiency by increasing

its tractive power from 85,040 pounds to 105,340 pounds. This remodeled locomotive is now undergoing test.

The Southern Pacific's Overland Route is the shortest of the main transcontinental rail arteries connecting the large productive regions of the Pacific Coast with eastern markets. From San Francisco Bay it travels northeasterly through the valley of the Sacramento and then climbs easterly across the Sierra mountains toward Reno and the east. The climb over the mountains is a gentle but continuous grade. To



The symbol familiar to travelers on the Lincoln Highway as it now appears. It is built of concrete

facilitate the heavy perishable traffic over the Overland Route, the company placed in service a number of "articulated compound Mallet consolidation" locomotives to operate between Sacramento, California, and Sparks, Nevada.

After a study of their operation over a period of time they were, with some excep-

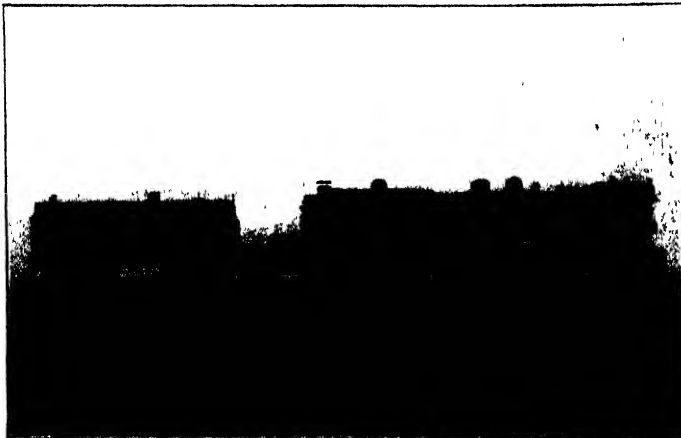
tions, found satisfactory for the type of service they were assigned to. These exceptions were that the locomotives in traveling down grade could not "drift" but had to "roll" under steam pressure. Another exception was that they could not travel fast enough for the service required. These two factors counted greatly against their operating efficiency. The company therefore made a study to determine how the locomotives could be rebuilt to eliminate these factors.

Last March the company released from its Sacramento shops locomotive C. P. 4028, the first of seven similar Mallets to be rebuilt. This locomotive had two high pressure cylinders with 26-inch diameter by 30-inch stroke, and two low pressure cylinders with 40-inch diameter by 30-inch stroke, giving a tractive effort of 85,040 pounds.

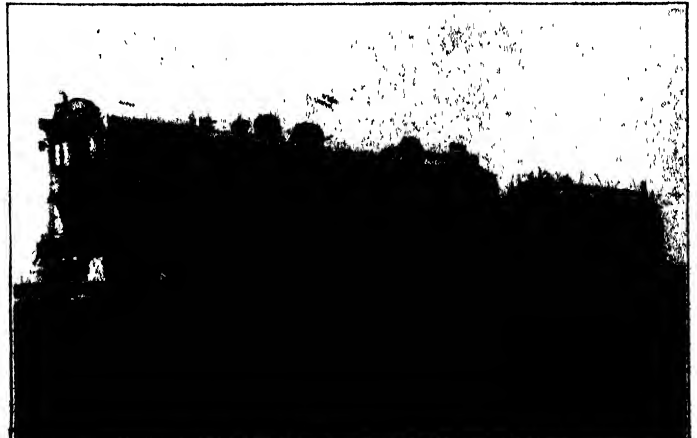
In the shops four new high pressure cylinders of 22-inch diameter and 30-inch stroke were built in the locomotive to give a tractive effort of 90,940 pounds.

The boiler was heretofore built in two sections—the forward section consisting of a preheater and smoke box, and the back, the firebox and boiler proper. The preheater was removed, the boiler being made all in one section, and the same overall length was maintained by the application of a combustion chamber to the firebox and slightly increasing the length of tubes. This improved the design to the extent that its evaporating capacity was increased about 16 percent. A front end throttle was installed in the smoke box, which location, in addition to supplying super-heated steam to the auxiliaries, has the advantage of giving the engineer better control in handling the locomotive, thus enabling him to prevent unnecessary slipping of the drivers. A type "E" superheater, open type feed-water heater and two mechanical lubricators were also installed.

The cab fixtures were rearranged to give enginemen a better view of the gages, and a new design throttle rigging was applied, giving easier control. In general, this



The Southern Pacific's locomotive that seems to run backwards. Note the eight powerful driving wheels on this side and the booster under rear end of the tender



Front end view of the locomotive that was rebuilt to give it greater traction. It is not a Mallet type so it has been called the "articulated consolidation" engine

arrangement provides more room in the cab which is now mounted on the forward end of the locomotive.

The water capacity of the tender was increased from 9800 to 12,000 gallons and oil capacity from 3112 to 3771 gallons.

A new front truck having greater capacity and larger journals was installed on tender and an auxiliary locomotive or booster was installed under rear of tender. This booster develops a tractive power of approximately 14,400 pounds in addition to that developed in the locomotive cylinders. The remodeled locomotive cannot now be called a Mallet as the name refers to a system of compounding an articulated engine first proposed by Anatole Mallet. It is, therefore, now called an "articulated consolidation" locomotive. Its efficiency is being tested by a dynamometer car.

Natural Lightning Writes Its Own Record

NATURAL lightning, untamed and destructive electricity that is measured in millions of horsepower and millionths of a second, has been made to write a record of itself. In the foothills of the Allegheny mountains near Lake Wallenpaupack, Pennsylvania, where engineers of the General Electric Company have been co-operating in experiments and investigations of the 220,000-volt transmission lines of the Pennsylvania Power and Light system for more than three years in an endeavor to ascertain the characteristics of lightning, the greatest enemy of high voltage transmission lines, a photographic record has been obtained showing the nature of a lightning stroke on transmission wires before reaching the ground. This is the first 220,000-volt line ever built in a lightning-infested territory, and the first in the world outside of California.

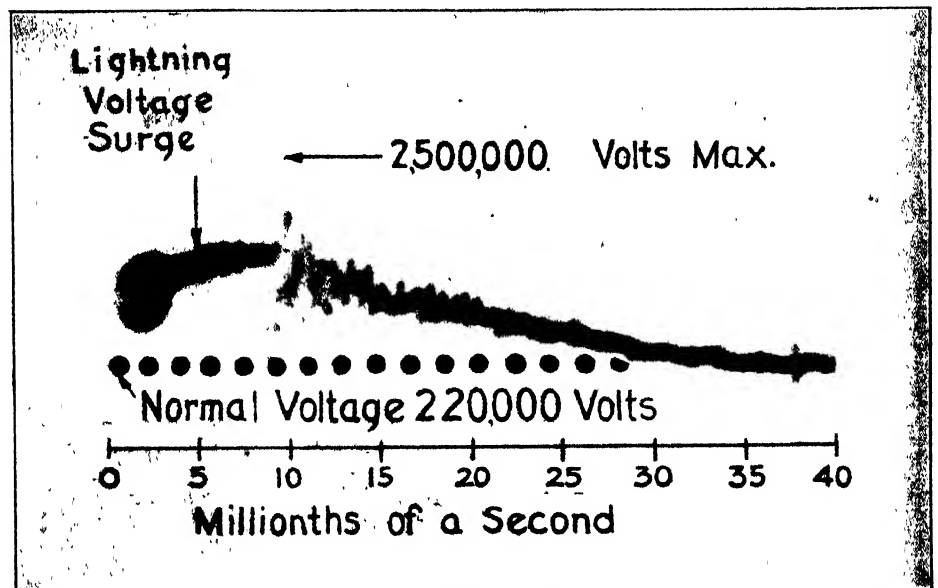
The accompanying picture, the first of its kind ever made in the world, reveals a stroke on the transmission wires of approximately 2,500,000 volts. It was made automatically by a portable cathode-ray oscillograph. This device can record what happens in a millionth of a second, or even a fraction of such a brief interval.

The General Electric Company, in co-operation with the Pennsylvania Power and Light Company, the Philadelphia Electric Company and the Public Service Electric and Gas Company, of New Jersey, began this study of natural lightning on transmission lines in 1925. The cathode-

ray oscillograph had not been developed at that time and various types of surge recorders were used. Early this summer, engineers of the above mentioned companies, with Mr. Peek, who is credited with having done more experimenting with artificial lightning than any other engineer and

Peek, Jr., in a paper presented before the Franklin Institute in Philadelphia in September, 1924, based on his many years of experimenting with artificial lightning.

This field laboratory was planned with the expectation of continued observations on natural lightning, with the realization



The record written by a stroke of natural lightning by means of the cathode-ray high-speed camera. Note the maximum surge at 10 millionths of a second

who recently announced an artificial flash of more than 3,500,000 volts, made an inspection of the 65-mile, 220,000-volt transmission lines extending from Wallenpaupack to Siegfried, and selected a location for the experimental laboratory.

Less than a week after the cathode-ray high-speed camera had been put in working order, the awaited thunderstorm arrived and the picture was taken. The negative showed that before five millionths of a second had passed the voltage wave had climbed to more than 1,500,000 volts. A local disturbance, due to an induction flash-over and reflection, caused a rise to 2,500,000 volts in a fraction of a millionth of a second. This splash or ripple then died down in a millionth of a second and the wave passed to below dangerous value in about 10 millionths of a second and then to zero.

This particular picture is especially interesting since it shows characteristics closely in line with predictions made by F. W.

that a great deal of data will be required for practical solution of lightning control on transmission systems.

Color "Movies" for Amateurs

THE Eastman Kodak Research Laboratories, under the direction of Dr. C. E. K. Mees, have been working for a number of years to perfect color movies. The most radically new element in the process is the film. Instead of having the usual smooth surface, the side opposite the sensitive coating is embossed with cylindrical lenses so minute as to be invisible. These lenses, which are part of the film itself and made of the film substance, would each look, vastly magnified, like a rib of a corrugated iron roof. They run lengthwise of the film and 559 of them occupies an inch.

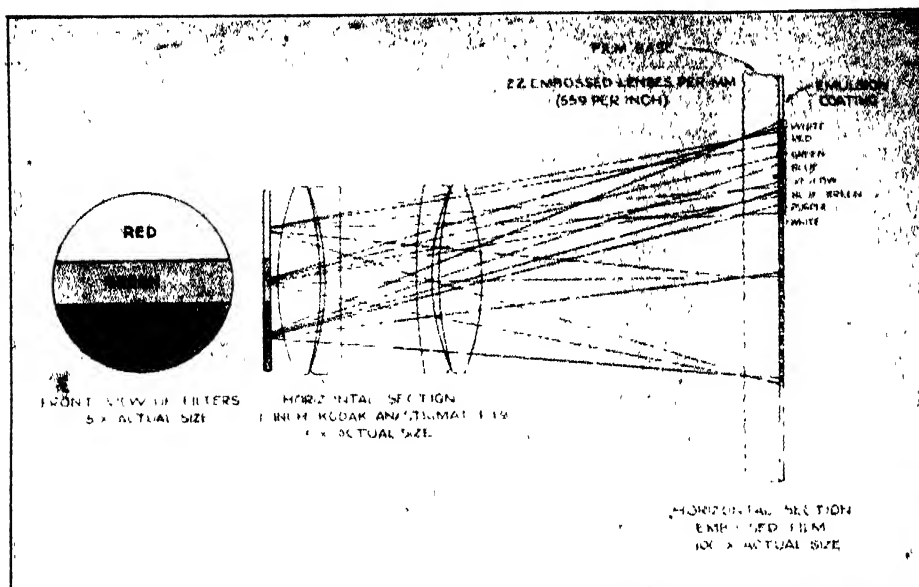
The effect of these invisibly small lenses is to separate the rays of light which come through the three segments of a three-colored "light filter" into the camera. Each



View of the exterior of the small building near Lake Wallenpaupack, Pennsylvania, where the first record of a natural lightning stroke was obtained by engineers



The cathode-ray oscillograph opened to show tube and camera. General Electric Company engineers are using this equipment to learn secrets of natural lightning



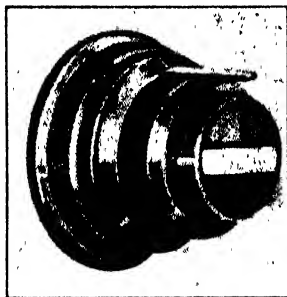
The manner in which the rays from the three filter colors are laid on the sensitive emulsion by the many minute embossed lenses of the new color films

of the three colors of the filter—red, green, and blue—lets into the camera, from the scene in front of the camera, only the light rays of its own color. The three differently colored light rays register on the film only as black and white; but each tiny lens embossed on the film so distributes the light rays falling upon it that the different colors register on the sensitive film emulsion as a

that he has observed these beautiful little game birds eating potato beetles. They seem to be about the only birds that will condescend to such a diet, for even ducks and guinea fowl, which will ordinarily eat anything they can get into their beaks, refuse to touch them.—*Science Service.*

A Power House on Stilts

IN order to avoid shortening the spillway length on dam Number 7 on the Kentucky River, the Kentucky Hydro-Electric Company designed a power house of unusual construction to utilize the normal fall of 15 feet at this point. Of the 14 dams and locks for slack navigation on the Kentucky River, Number 7 is the shortest, with a spillway length of only 340 feet. As a maximum flood stage has been known to give 27 feet of water on the spillway with no fall, it was considered highly undesirable to build a power house directly on the dam.



The color filter used in the new Eastman color "movie" process

distinct black and white impression for each color at that point.

The light of the projector then passes through the film in such a way that it shines out through the tiny film lenses, and then through the projector lens; and each ray is directed through the proper color on the light filter, to fall on its proper spot on the screen. The combination of the three colors, red, green, and blue, gives every possible natural color.

The process is first being introduced for the use of amateur photographers.

The most significant thing about the new process is its complete simplicity. The amateur cinematographer's part has been made as easy as taking snapshots. He merely has to insert a "color filter" into his home movie camera and thread his special film. All previous color motion picture processes have entailed highly complicated cameras and finishing methods.

Bob White Eats Potato Bugs

SMALL boys, getting aching backs and no fun at all hunting potato bugs in the parental potato patch, may well sigh for the company of a few southern quail. N. L. Wiley of Beaufort, North Carolina, states

The high cliff at the end opposite the lock made it impractical to build the power house beyond that abutment. The problem was solved by placing the power house over the dam on stilts, as it were, and above flood level. This left the spillway practically unobstructed.

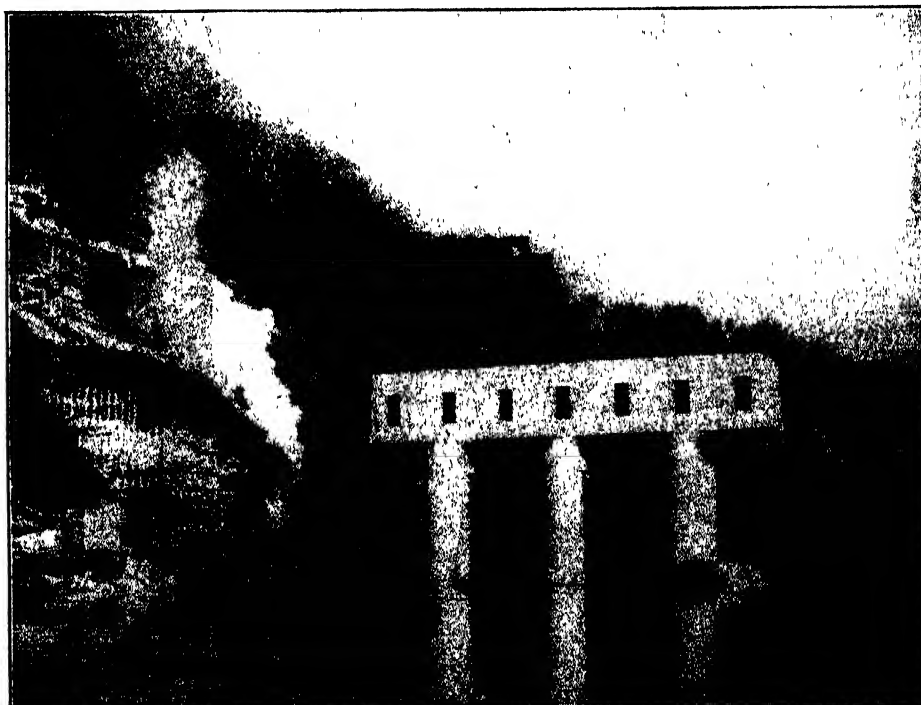
In the power house, which is 21½ feet by 91 feet, there are three generators with an aggregate capacity of 2000 kilowatts. The three hydraulic turbines driving these generators are installed in pits built with their roofs level with the crest of the dam. Over the wheel pits is a deck which supports the trash rack. Upon this deck, which forms a part of the spillway of the dam, are three piers about 50 feet high, which support the power house. These piers are centered directly over the turbine



Dr. C. E. K. Mees, who has been given credit for new color "movies"

shafts which pass up through the piers into the generator room, being thus protected from floating drift. At the outer, or river, end, the power house has a cantilever extension over the dam while a similar extension at the shore end provides room for the switchboard and auxiliaries,

(Please turn to page 371)



Courtesy Engineering News-Record

Power house on the Kentucky River, erected 50 feet above normal water level in order to be above high water and to preserve the full length of the dam

This genuine wood board is grainless and won't check or split!

Possesses uniform strength and remarkable workability. Highly resistive to moisture. Very tough and dense. Has a smooth, attractive surface on the face side, and requires no paint for protection. Also takes any finish beautifully. Send for large, free sample.



FOR PANELING

A decade ago no one ever dreamed that there would be such a thing as *grainless* wood. Yet it has now been on the market for more than two years, and new uses are being discovered for it right along.

The name of this product is Masonite Presdwood. And remember that Presdwood is *all wood*; genuine wood torn apart and put together again.

Presdwood will not crack, check, split or splinter. It shows minimum contraction and expansion under the most severe working conditions. Stoutly resistive to moisture and to sudden changes of temperature, it is practically immune to warping, shrinking, swelling, buckling.

It cannot damage tools

Presdwood contains no grit, no resin, no foreign matter of any kind. It cannot damage tools. Convenient and easy to handle it also eliminates waste in cutting. And it frequently reduces the number of manufacturing operations.

Presdwood has a very smooth, attractive surface on the face side and requires no paint for protection. It also takes any finish beautifully: lacquer, paint, stain or varnish.

Another one of the outstanding advantages of Masonite Presdwood is that it can be used on any woodworking machinery, and possesses amazing workability. In fact, it is so widely adaptable

that the number and versatility of its uses seem to be unlimited.

These uses include signs, both outside and inside; cut-outs of all kinds; breakfast nooks and kitchen cabinets; closet lining and display booths; paneling, interior finish and office partitions; radio boxes; showcases, show window flooring, store fixtures and table tops; bedroom screens and fire screens; toys, tension boards for radio speakers and portable billiard tables; Sager boards for potteries; forms for reinforced concrete; truck bodies; motor boat hulls.

Where next?

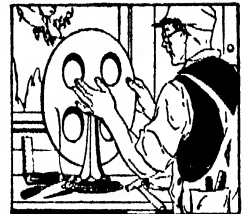
Where will Presdwood be used next? Nobody knows!

Within the past few months it has gone into the making of cooling trays for hot castings, incubators, clothes hampers, work-bench tops, starch trays for candy-making, flower boxes, doll houses and concrete forms.

And just recently it has come into demand for cafe nooks and for the fences of baseball parks! Thus you see that there is really no limit to the uses for Presdwood. Write for a free sample and find out what it will do for you.

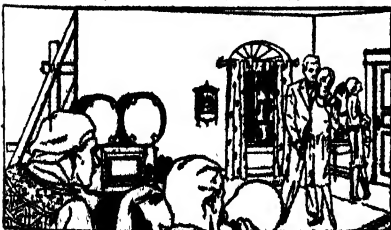
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IN MAKING MOVIES



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Made by the makers of
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IN BUILDING BOATS



Learning to Use Our Wings

This Department Will Keep Our Readers Informed of the Latest Facts About Airplanes and Airships

CONDUCTED BY ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York City

Intercollegiate Flying Contests

GROVER C. LOENING, the well-known airplane designer, has given a sum of 5000 dollars for an Intercollegiate Flying Trophy. The first contest will be

particularly among University students.

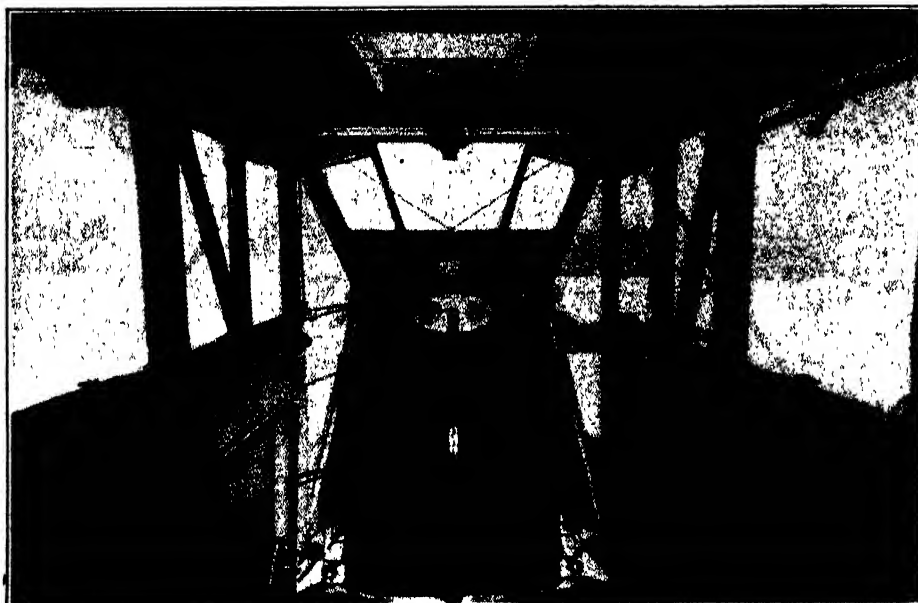
The Flying Club of New York University is particularly fortunate in having secured the loan of a Curtiss Robin. The planes must be powered with an OX-5, 90-horse-

airfoil section. Thus they are not simply resistance producing elements, but themselves contribute to the lift of the wings.

Popularizing the Glider

THE history of gliding in the United States is mainly a record of the scientific work of the great pioneers, Montgomery, Chanute, and Wilbur and Orville Wright. The famous English pioneers of the first half of the Nineteenth Century made valuable theoretical investigations and many flights with powered models. They may be said to have "invented" the airplane.

But the airplane would never have been



Looking forward in cabin of Curtiss Robin. Note the clear vision possible

held at Mitchel Field, Long Island. Student teams from colleges and technical schools must include three men who hold Department of Commerce licenses. Each

power engine, and the Robin is the most modern plane designed around this engine.

In the old days a Curtiss Jenny with an OX motor, with open cockpit, and carrying but a pilot and one passenger, was regarded as an efficient ship, when its maximum speed was only 73 miles an hour.

The Robin, in spite of its relatively small power, is a three-place, cabin plane, having a maximum speed of nearly 100 miles an hour, with a cruising speed range of 785 miles, and a service ceiling of 12,800 feet.

The bracing structure of the plane is particularly neat. The no-axle chassis is hinged at the bottom of the fuselage. The telescopic member runs up to the front wing-struts, providing a wide tread with the lightest possible landing gear. The struts supporting the wing are wide, and of



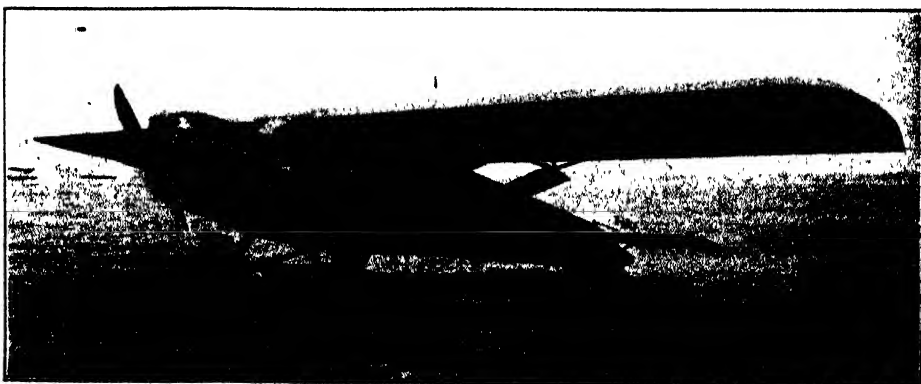
Instrument board and controls in pilot's cockpit of the Robin plane

reduced to practice without the hazardous experimental work of the glider exponents. The earliest, authentic, man-carrying gliders were built by a French sailor, Captain Le Bris, who, without much scientific training but with wonderful instinct, performed some wonderful glides in the



Looking back in cabin of Robin. Two seats at rear are for passengers

of the men will fly the same ship through a gigantic circle, a mile high and marked out by a number of Army observation planes. The keenest rivalry has been aroused, and the event will do much to promote flying,



The exterior of the Curtiss Robin, a cabin plane with 90 horsepower engine

International Truck Triumphs Over Sahara's Wastes



"Baron Blixen drags his weary steps toward the drums. What an eternity it takes—"

IF I WERE asked to state why Baron Frederik von Blixen-Finecke and I crossed the Sahara by truck, I could only answer that in doing so we attempted and accomplished something which everyone claimed was impossible. We both felt that, having gone so far as buying an International Special Delivery for the trip, we would ignore advice and go on.

On March 26th we started our adventure from Kano, in Nigeria. Out of Zinder, appalling heat enveloped us, our thermometer registering 125° in the shade. Progress from Niamey on was slow, barely averaging ten miles per hour.

The desolation at Tabankort, an abandoned military post, would drive most white men crazy in a month. The heat is beyond description. The water is almost as salt as the sea, so we decided not to fill our two 10-gallon drums as we should pass another well called Asselagh, farther on. The going became steadily worse. At dusk we came to the conclusion we had missed the well. We were faced with the alternative of going on or of turning back.

Either way courted death and a terrible one, but we decided to go on. At 2:30 A. M., we were compelled to stop, overcome by exhaustion. A small glass of water and dry biscuits for us, but not a sound of complaint from our wonderful truck. The

Thrilling story of first four-wheel truck to conquer 3,000 miles of world's greatest desert, by

SIR CHARLES MARKHAM

British soldier, explorer and big-game hunter

going became worse, involving corrugated iron sheets under the wheels, which otherwise would have sunk to the hubs in sand. Four feet forward—stop. Scratch sand, replace sheets, again forward four feet. There was less than a gallon and a half of water left. Our International was boiling constantly but kept faithfully on and every drop of water poured into the radiator was like parting with our life's blood. Finally, a speck on the horizon! Our hopes rise, "What is it," we cry, "can it be water?" Hardly can we curb our impatience. We reach the steel drum. Empty! Our hopes are dashed and both secretly think we have come to the end of our last journey.

The next day, we ran into a deep valley or sand. The truck sank in to the axle. Only a quart of water left—for the engine, or ourselves? We compromised with a mouthful apiece and the car drank the rest. Progress was terribly slow, the truck shuddering under the terrific strain from the resistance of the sand, but coming through with flying colors. We climb a small escarp-

ment, and see, barely a mile away, five drums standing in solitary state. Are they empty, or filled with water or petrol? Baron Blixen drags his weary steps toward the drums. What an eternity it takes to cover that mile; but eventually he reaches them.

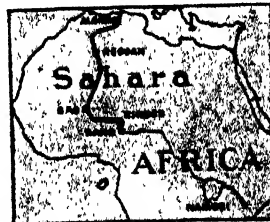
It is water! With feverish haste we drink the precious liquid which means life.

Next morning we were off into the Tan-zaruf Desert, where it has never been known to rain, and reached Reggan two days later. On April 12th we reached Algiers, having covered 4,535 kilometers (2,818 miles) in sixteen days. From Kano to Algiers, we consumed 156 gallons of petrol (187 U. S. gals.)

We were not only glad to have accomplished the journey, but to have done it in a regular stock model International Truck, without special equipment or preparation, other than extra fuel, tires, and water; no spare parts of any description were carried—or needed.

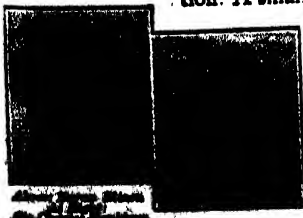
NOTE: These are short excerpts from this adventurous journey across Sahara. International Harvester will be pleased to send you with its compliments, the complete story of Sir Charles, in booklet form, profusely

illustrated. Use coupon below.



International Harvester Company of America, Inc.
610 South Michigan Ave., Chicago, Ill.
I would enjoy reading the full story of Sir Charles Markham's journey across Sahara.

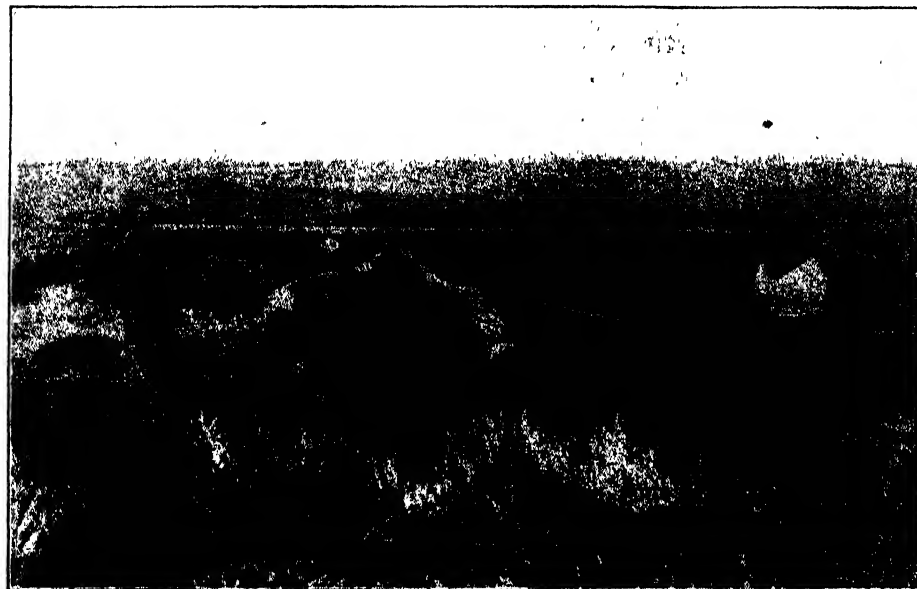
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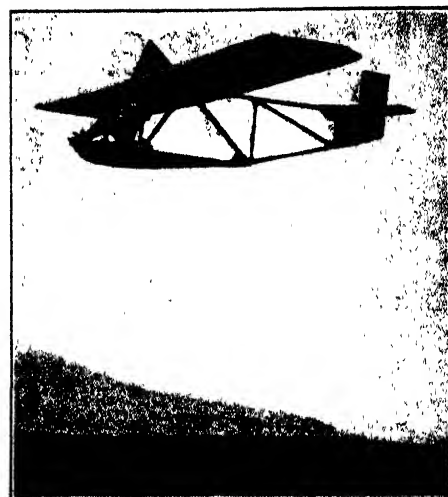
Seventies, using wings shaped like those of an albatross.

The most famous glider exponent is probably Otto Lilienthal, a German, who began experimentation as early as 1867. Lilienthal built monoplane gliders, with cambered wing surfaces, but otherwise of rudimentary construction. The rider's arms passed through padded tubes fastened to the under-surface of the wing; his body and legs swung freely underneath. Lilien-

thals excellent ideas until 1905. His experiments with the *Santa Clara* were made with the aid of a hot-air balloon. An aeronaut named Maloney took up the balloon to a height of 4000 feet, cut loose and performed a number of perfect evolutions before alighting. While Montgomery's experiments are quite rightly overshadowed by the marvelous work of the Wright brothers, his contributions to airplane control, and to the understanding of the advantages of



The famous Darmstadt glider, which is being tested in this country



A typical "school" glider

for the first time, securing control about all three axes of the airplane. The wonderful success which Orville and Wilbur Wright achieved with their first powered craft was due not only to their general engineering ability and their wind-tunnel experiments, but also to their careful preparatory work with the Wright gliders at Kitty Hawk, North Carolina.

Even after their successful conquest of powered flight, the Wrights did not lose their interest in gliding and in 1911 they made a record soaring flight of nine minutes and 45 seconds, which remained the record until 1922 when the German Hentzen stayed aloft for the remarkable time of 3 hours and 6 minutes.

The endurance record made by Hentzen aroused great interest in the United States, and even created in the public mind an exaggerated importance of the possibilities of the art.

Although there is not the slightest possibility of gliding becoming a means of transportation, it offers real interest. It is a delightful sport, which, when properly conducted, offers very little danger. Gliders are simple and inexpensive to build and provide a ready outlet for young aviation enthusiasts who cannot find the means or parental permission for powered flying. It is a splendid preliminary training for airplane flight.

It appears extraordinary, therefore, that gliding as a sport has not yet taken root in the United States. A glider has been built and flown by the students of the California Institute of Technology. Another glider was built by the students of the Massachusetts Institute of Technology, and entered, although without participation, for a foreign meet in 1923. Nordman, an aeronautical engineer, made some glides on Long Island, after being towed by a

(Please turn to page 374)

thal's first man-carrying glider was built in 1891.

Lilienthal was firmly convinced that to achieve human flight it was necessary to get practice in flying in some way. In this he was perfectly right. He made the mistake, however, of relying almost solely on the movements of the rider's body and legs for securing controllability. In spite of this, Lilienthal made some wonderful glides during the years 1891 to 1897 and contributed a great deal of knowledge to the art, before the accident in which he was killed.

To John J. Montgomery belongs the honor of making the first glide on United States soil. In 1884 he constructed gliders which used two cambered surfaces arranged in tandem, and which were equipped with horizontal rudders, and seats which could be swung from side to side to secure lateral control. Montgomery also employed a fixed vertical rudder, and also means for swinging the rear portions of the wing tips, thus anticipating modern aileron control. His very first glide, was 600 feet in length.

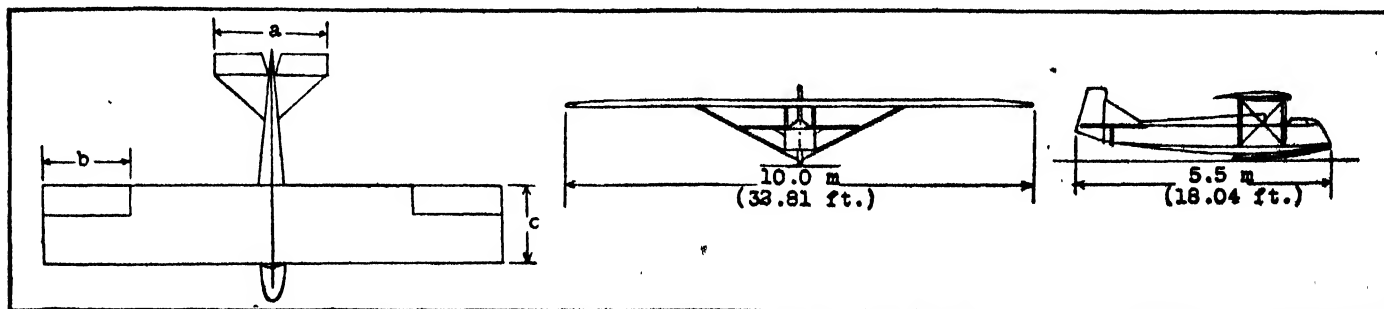
However, Montgomery did not find an opportunity of giving full scope to his

the cambered wing surface, are remarkable.

Montgomery seems to have been a very independent, as well as a very scientific worker. It was Octave Chanute who brought the Lilienthal tradition to America. Chanute, a civil engineer of established reputation, devoted all the last years of his life to gliding and aerodynamics, and after careful study of Lilienthal's work, went into camp on the sand hills of Dune Park on the southern shores of Lake Michigan. Here during the year 1896 he made over 1000 glides without an accident, performing many glides himself in spite of his advanced age of 64.

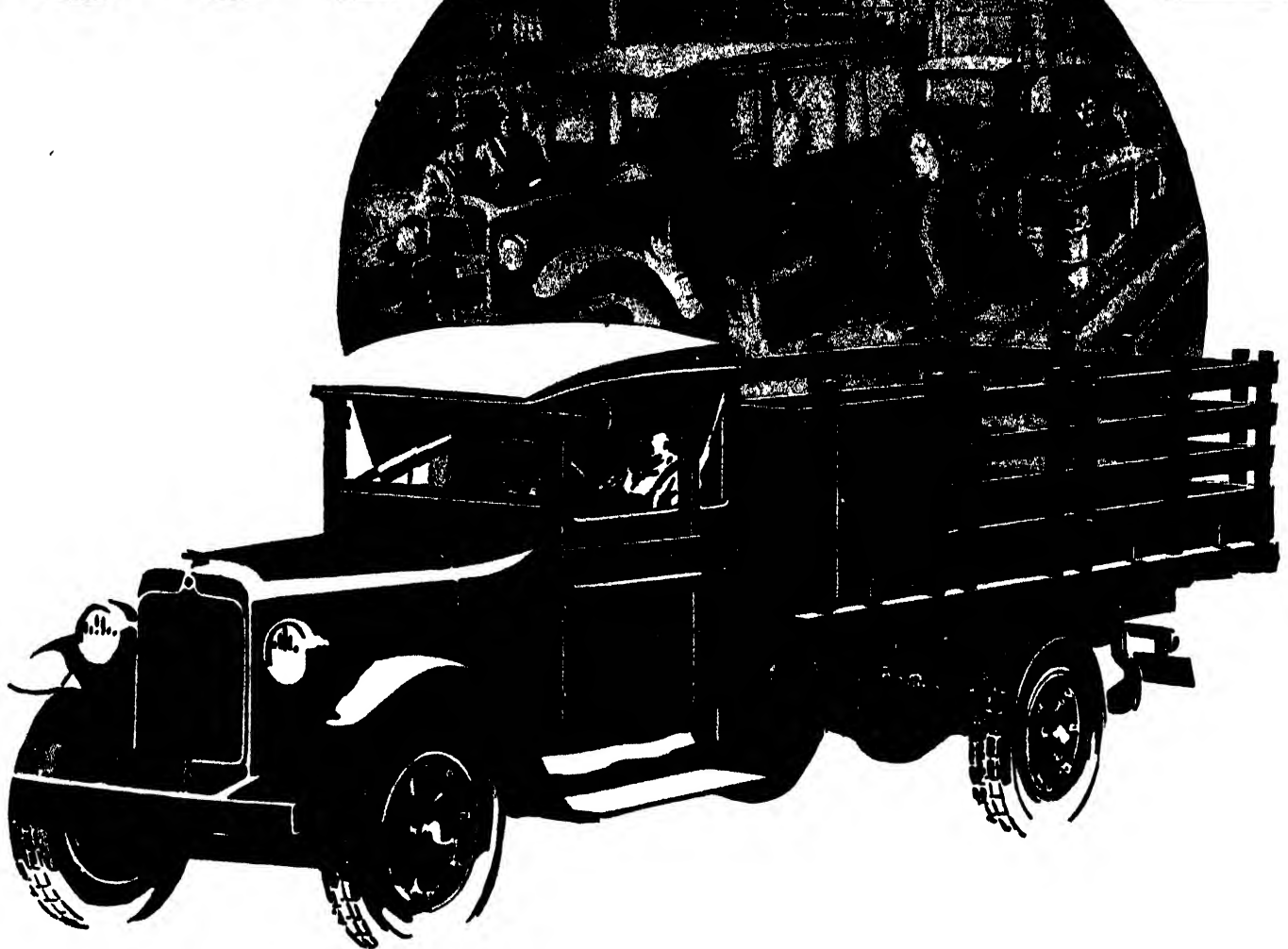
Chanute evolved a remarkable biplane glider, braced in the most approved form of a Pratt truss. Chanute still had the rider's body swung from the lower surface of his wings, but did not rely on skilled contortions alone for control. He employed a horizontal rudder, and swung the wings on either side in a fore-and-aft direction to secure lateral control.

It remained for the immortal Wright brothers to achieve the final solution of the problem of airplane control by combining a horizontal rudder and a movable vertical rudder with warping wings, thus



Line drawings showing constructional details of a typical training glider

COMPLETE



PRICES	
MERCHANTS EXPRESS —110' wheelbase	\$ 665
COMMERCIAL TRUCK —120' wheelbase	775
1½-TON—130' wheelbase	995
1½-TON—140' wheelbase	1065
1½-TON—150' wheelbase	1345
1½-TON—165' wheelbase	1415
2-TON—150' wheelbase	1545
2-TON—165' wheelbase	1615
3-TON—155' wheelbase	1745
3-TON—165' wheelbase	1775
3-TON—185' wheelbase	1845

Chassis f. o. b. Detroit

COMPLETE trucks . . . a complete line of trucks . . . complete owner satisfaction . . . So runs public appraisal of Graham Brothers Trucks.

They are built by one manufacturer—chassis and bodies. They are sold by one dealer—complete, ready to work.

Graham Brothers Trucks are all sixes. All have 4-wheel brakes. Six cylinder power . . . Six cylinder speed . . . Six cylinder flexibility and operating ease . . . The snap of six-cylinder acceleration and the safety of 4-wheel brake deceleration . . . Four speed

transmission on 1½, 1¾, 2 and 3-ton trucks.

All these features at extremely low cost—and without sacrifice of the rugged dependability and operating economy the world has learned to associate with everything Dodge Brothers builds.

Let your Dodge Brothers Dealer show you the exact size and type for your business. Compare it—for price, for value, for appearance, for its ability to do your work and make you money—with any truck you ever considered good value.

GRAHAM BROTHERS TRUCKS

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DEALERS EVERYWHERE

Strays From the Ether

A Monthly Review of the Progress Made In All Branches of Radio Communication

Movies by Radio

RADIO'S most conspicuous leaders met at the plant of the Westinghouse Electric and Manufacturing Company recently to review the laboratory progress of what the layman might term imminent miracles of sight and sound transmission.

The most striking of all radio developments discussed was the broadcasting of motion pictures which, transmitted on radio waves, were picked up on a receiver



Dr. Frank Conrad and the television movie transmitter which he designed and is perfecting

located in the Westinghouse television laboratory and reproduced before those assembled there.

While radio movies are still in the laboratory stage, the event heralds the time when the radio listener will sit at home and have that most popular form of entertainment, motion pictures, projected by his own individual radio receiver.

The development of radio movies is a triumph of scientific engineering. Barely two months ago, the idea came to the mind of Dr. Frank Conrad, in charge of this branch of his company's activities, and the fact that he has brought the device to the laboratory stage in the degree of perfection witnessed, is said to have set a record.

Radio movies are a step beyond previous developments in television and required the invention of a number of appliances in addition to a great deal of scientific calculation, synchronization of various high-speed mechanisms, and accurate control of light and radio waves.

Photography in its simplest form consists of the reproducing of spots of light and shadow in the same arrangement as they appear in the subject photographed. The screening of a motion picture requires that a roll of film be operated at a speed which sends sixteen pictures a second before a projecting beam of light. Because of the structure of the human eye, if a series of pictures follow each other at the rate of 16 or more per second, the human eye sees it as a single moving picture.

All this the broadcasting of radio movies requires, with the addition that the spots of light must be transformed into frequencies, (some of which are in the audible

range), transferred to a radio wave and broadcast as electrical energy. In receiving the pictures, the process is reversed—the electrical energy is picked up, and the frequencies returned to lights and shadows, which when viewed present the radio movie.

In the first step of the process a pencil of light traverses each picture, or "frame," as it is called, at the rate of 60 times in a sixteenth of a second. This process produces a 60-line picture, as clear as the usual newspaper halftone illustration.

The pencil of light is produced by a scanner, which is a disk with a series of minute square holes near its rim. The disk is so arranged that all light is excluded from the film except that which goes through the square holes. The disk turns very fast, and as it turns it passes the square beam of light across each "frame," with the result that an individual beam of light touches every part of the "frame."

The beam of light, passing through the film, falls upon an electric eye or photoelectric cell, which is not unlike an oversized incandescent lamp. Within the cell, however, is a metal whose electrical resistance varies with the light falling on it. Caesium, a rare metal, is used in the Westinghouse cell. The amount of light falling on this cell determines the amount of current passing through it. The result is that each individual beam of light sends an electrical impulse which varies directly according to the amount of light or shade in the film through which it passed.

The beams of light have now become electrical impulses and are sent on to the broadcasting station. Here the beams assume definite and varied frequencies, some of which are audible. Dr. Conrad states that these frequencies range from somewhere near 500 to approximately

60,000. Since the human ear is limited to frequencies of approximately 15,000, much of the radio movie wave is inaudible.

At the broadcasting station these frequencies are used to modulate a radio wave and are transmitted exactly as the ordinary music or voice. The radio signals now can be sent across a room, or across the continent. Their distance range is limited only by the broadcasting station's equipment.

In the Westinghouse demonstration, the signals traversed a distance of about four miles; two miles from the laboratory to the broadcasting station by wire and two miles back to the laboratory by radio.

To turn these radio waves back into light, an arrangement which permits the use of a mercury arc lamp is used. By this adaptation the weak radio currents control the action of the many times more powerful current operating the arc lamp. This action may be compared to the action of a radio tube, where the weak radio current on the grid of the tube controls the action of the independent and more powerful plate current.

Thus the mercury arc lamp goes bright or dim as fast as the current changes and its light at any instant is in proportion to the light that the electric eye sees in the same instant. To return the dots of light to their original pattern, another revolving disk or scanner is used, which is similar to the transmitting scanner.

Both these scanning disks turn at exactly the same speed; the hole in the receiving disk must be exactly in the same relative position as the corresponding hole in the transmitting disk. In other words, they must be synchronized.

Westinghouse engineers were the first to develop a feasible method of synchronism and their method was by means of



Dr. Conrad is shown here adjusting the instruments of the television transmitter for motion pictures. Notice the strip of film placed in the mechanism

LUCKY STRIKE
"IT'S TOASTED"
CIGARETTES

Amelia M. Earhart

Amelia M. Earhart, first woman to fly the Atlantic by aeroplane
says—

"Lucky Strikes were the cigarettes carried on the 'Friendship' when she crossed the Atlantic. They were smoked continuously from Trepassey to Wales. I think nothing else helped so much to lessen the strain for all of us."

"It's toasted"
No Throat Irritation-No Cough.

© 1928 The American Tobacco Co., Manufacturer

radio. From the transmitting equipment, which may be located in the broadcasting station, they transmit a constant frequency wave of 5000 cycles. This wave is produced by a tuning fork and transmitted over a special carrier wave from the broad-

and motor noise absolutely disappeared. Furthermore, the strength of reception was increased 50 percent, and there was a marked increase in selectivity. The motor noise was coming to the set in the original installation through the common ground

Belgium. This magazine has been printing diagrams in the Braille system which enable those deprived of sight to construct their own radio receivers without assistance.

Instead of the usual printed symbols, this magazine publishes embossed diagrams of receiving circuits, using raised lines of dots to indicate wires, and a raised "picture" to show what instrument is to be used.

Short Wave Adapter

THERE is now on the market an excellent type of short wave adapter for use with broadcast receivers. It was designed by E. T. Flewelling and is being manufactured by the A. C. Dayton Company of Dayton, Ohio.

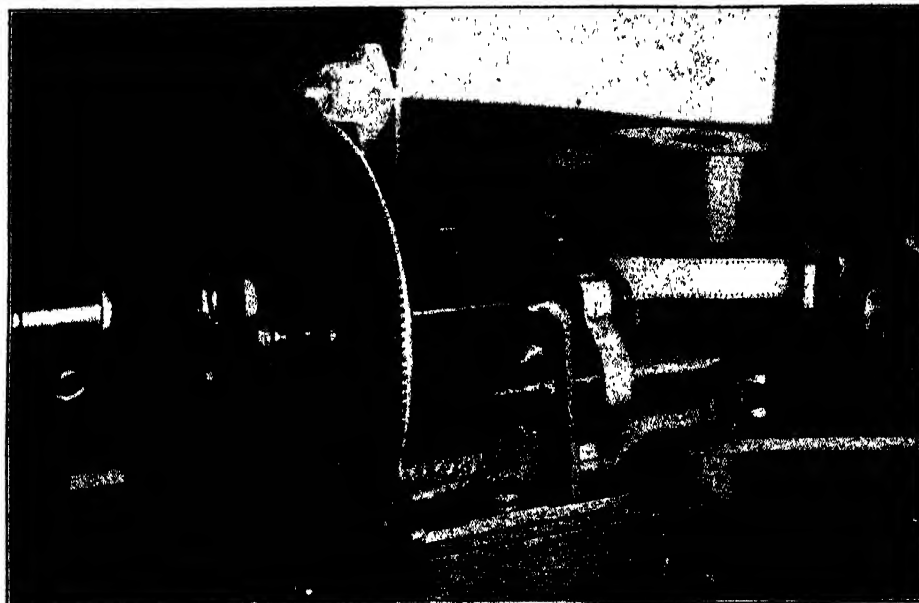
The adapter is designed to be plugged into the detector socket of a standard broadcast receiver, whereupon the audio amplifier and the loudspeaker of the regular receiver will be employed for reproducing the short-wave signals. Thus it will be seen that an adapter of this type can be used with any broadcast receiver which employs an audio-frequency amplifier.

Oscillation Control

ALTHOUGH there are many methods of controlling oscillation in radio-frequency amplifying circuits, most of them have serious drawbacks. One of the best and simplest is that wherein a resistance is placed in a series with grid lead of the radio-frequency tube. A standard clorostat is satisfactory for this purpose as its range is variable and the best setting for the particular instruments employed can be readily obtained. One of the advantageous features of this method of oscillation control is that amplification decreases slightly at the higher frequencies. Since feed-back increases with frequency, the decreased amplification will prevent excessive feed-back with its consequent unbalancing of the circuit.

The above outlined method has one disadvantage in that it broadens the tuning somewhat. To avoid this, the same type

(Please turn to page 368)



A close-up of the radio movie projector. Note the spot of light that reaches the film through a small hole in the scanning disk. This system of sending motion pictures by radio is one of the latest developments of television, but follows to a great extent in the footsteps of past accomplishments in the art

casting station. The constant frequency note is received and by means of special apparatus controls the speed of synchronous motors, which drive the scanning disks of both transmitting and receiving radio movie equipment.

Sweden Heads Europe With 53.6 Radio Sets to Every 1000 People

ACCORDING to late statistics, Sweden is leading all European countries in radio. There are in Sweden 53.6 radio sets to every 1000 inhabitants, in England 53, in Norway 22.1, in Switzerland 15.9, in Czechoslovakia 15.2, in Denmark 44.8, in Austria 43, in Germany 32, in Hungary 9, in Finland 6, and in Belgium 4.1.

Counterpoise

WHEN experimenting with a radio receiving set in a location where man-made static was excessive, David Grimes, a well-known radio engineer, recently found that a counterpoise proved to be almost a perfect solution of the problem. Thinking that many of our readers may have similar trouble, we quote Mr. Grimes from the New York Sun as follows:

"A counterpoise installation was decided upon as being the best of a bad bargain. There was simply nothing else that we could do. A Number 14 copper rubber-insulated ground wire was run out of the window and strung horizontally around two sides of the building. It was attached and hung from several window sills on the same floor. We hooked up the set to the antenna, which was located on the roof, and to our new counterpoise as a ground, instead of using the common ground connection in the building. The counterpoise was not connected in any way with the ground. In fact, the set was not 'grounded' at all in the ordinary sense.

"The results were nothing short of a miracle! All trace of the man-made static

connection and not by direct radiation and pick-up through the antenna. By removing the set from this ground this source of interference was eliminated. As soon as the counterpoise was employed the signals increased and the tuning became sharper because the antenna and counterpoise were much lower in resistance than the antenna and the long common ground connection previously used."

Radio for the Blind

BLIND radio fans obtain the latest news of circuits and the like through the *Courier-Braille*, a publication for the blind, which is distributed in France and



Miss Elizabeth M. Zandonini of the Radio Laboratory of the Bureau of Standards, who has gone to France and Italy to study amateur radio station conditions there. She is an active member of the American Radio Relay League

Standards, who has gone to France and Italy to study amateur radio station conditions there. She is an active member of the American Radio Relay League

Have you tried it AFTER SHAVING?



Amazing—Invigorating

AFTER your next shave, douse Listerine on the face full strength. What a nice reaction. Cooling! A new sense of vigor and freshness. Amazing stimulation for tired skin. And all the usual smarting and burning gone at once.

Also you have the satisfaction of knowing that the antiseptic essential oils of Listerine are enemies of infection. One trial of Listerine this way will win you. Why not today? Lambert Pharmacal Co., St. Louis, Mo., U. S. A.

Have you TRIED the new
LISTERINE SHAVING CREAM?

Cools your skin while you shave
and keeps it cool afterwards.
An outstanding shaving
cream in every respect.

L I S T E R I N E

THE SAFE ANTISEPTIC

Industries From Atoms

A Department Devoted to the Advancements Made in Industrial and Experimental Chemistry

Asphalt Emulsion for Curing Concrete

WHILE to the casual observer it would appear that the constantly growing trend toward concrete as a material for highway construction will gradually supplant asphalt, it begins to appear that concrete roads will eventually offer

Most previous attempts to plate on aluminum for trade purposes have proved unsuccessful due to its peculiar position in relation to other metals in the electro-motive series and the problems which this position presents. Consequently, urged by the necessity for developing a more favor-

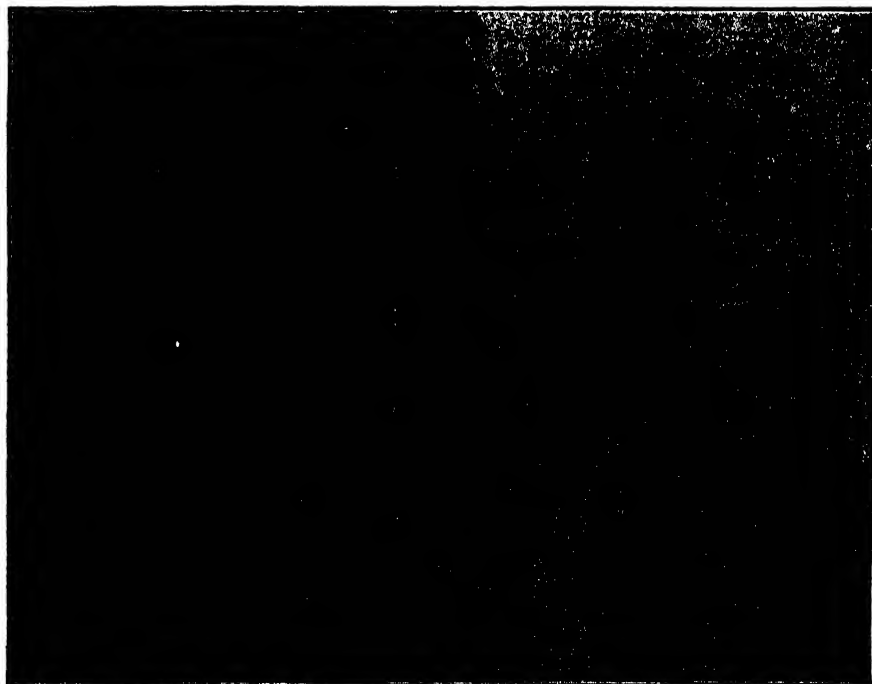
able means of electro-plating on aluminum and its alloys, the Aluminum Company of America established a research fellowship at Mellon Institute in 1925. After a study of nearly three years, the results of the fellowship's incumbent, Harold K. Work, were presented recently at the 58th general meeting of the American Electro-Chemical Society held in Bridgeport, Connecticut.

After the surface has been cleaned and rendered active, Mr. Work submits the aluminum to a roughening process. This is accomplished preferably by chemical etching which consists of placing the metal in an acid dip, the composition of the dip being determined by the alloy to be plated. When the alloy is such as will take a high metal dip, the surface of the aluminum is not only pitted by the action of the dip, but an immersion layer surface is formed which greatly facilitates plating. Pits thus formed in the surface of the aluminum serve to secure the plating.

The roughened metal is then immersed for the first coat in a nickel plating bath to which an electric current is applied. A nickel finish over aluminum is particularly desirable since the similarity in the color of the two metals renders worn spots in the plating less perceptible and the white corrosion products are more easily removed than those of other metals.

Titanium Takes Its Place as Paint Pigment

RECENTLY a new pigment for white paint, possessing rather remarkable qualities, has become available by the erection of a plant in Baltimore by the Commercial Pigments Corporation. Instead of



This close-up view of a section of concrete shows at the right the cracks in a hay-cured portion, and the breaking down of the edge at a longitudinal joint. At the left is a section cured by the Curcrete method, free from cracks

an excellent market for the producers of asphalt. This development is the result of research work on the properties and uses of asphalt emulsions.

The Barber Asphalt Company, for example, one of the largest producers of asphalt in America, has recently developed a material known as Curcrete. This is an asphalt emulsion used in curing concrete highways, foundations, sidewalks, floors, platforms and other flat slab surface construction. The emulsion is applied to newly finished concrete by a sprayer and produces a continuous glossy film which materially retards the evaporation of water.

The Curcrete method is claimed to result in a more uniformly cured slab of increased strength. It prevents surface cracking, checking and scaling and gives increased resistance to surface abrasion. It eliminates the usual puddling or hay-curing. Curcrete leaves a pleasing darkened surface which effectively prevents the glare common to the concrete highway.

Electro-Plating on Aluminum

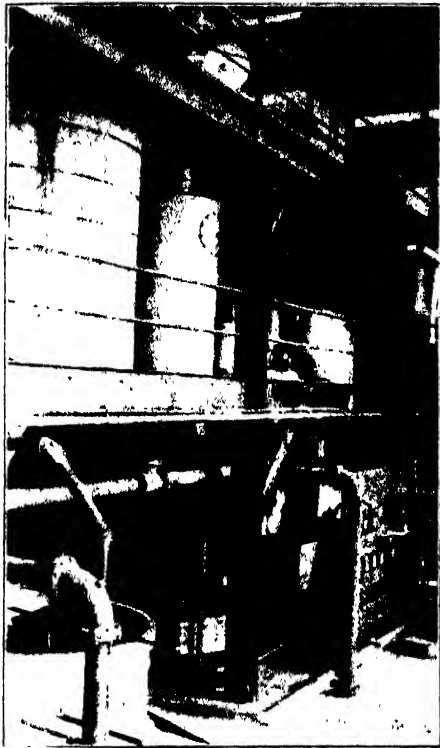
DESPITE its valuable characteristics of lightness and ease of manufacture, aluminum has not attained commercial importance in the field of plated metals.



Curcrete in the form of a fine spray, is applied to freshly finished concrete. Notice that the spraying is being done within 100 feet of the concrete mixer

lead, the less common metal titanium is the basis of the new paint material. Titanium dioxide is not a novelty, having been prepared in the laboratory long ago. This company, however, is the pioneer in its commercial production and it is extremely interesting to note that the process employed duplicates that used in the laboratory almost exactly except that huge vats are used instead of beakers and test tubes.

Bruce K. Brown, writing in *Chemical and Metallurgical Engineering*, describes the newly developed process. The titanium dioxide is extracted from ilmenite, a



Where "whitest white" paint is made from titanium oxide

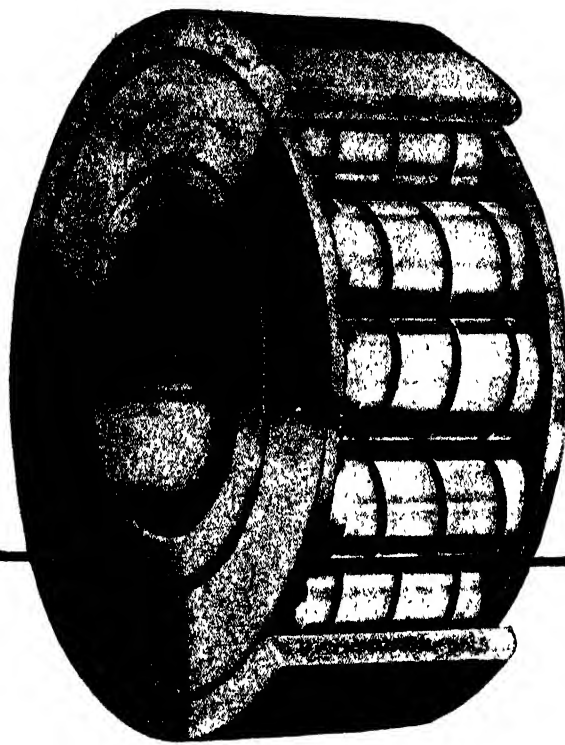
titanium-iron ore. The new plant produces 10 tons of pigment daily and 40 tons of ferrous sulphate (copperas) as a by-product.

The titanium dioxide pigment obtained by this series of operations is characterized by having a higher hiding power than any other known white pigment. It is a very pure product, containing less than .005 percent total of iron. Special processes developed by the corporation permit the production of a pigment having an oil absorption of about 25, which is considerably less than that of titanium dioxide pigments previously available on the market. The diversified uses and exceptional qualities of titanium dioxide pigments are so well known that they need not be discussed here.

This plant also produces titanium dioxide in the form of an unfilterable colloidal dispersion containing as much as 400 grams per liter of titanium dioxide. Experiments have shown the value of this material in the production of refractories and mineral glues, and research has demonstrated the possibility of using it to replace tin in the weighting of silk and in other analogous fields.

Washing Machines in Industry

ONE large manufacturing concern in the east has taken a page from the housewife's book and is effecting a yearly saving



Where Strength and Economy Unite!...

THE rare combination of mechanical ruggedness with reduced operating costs has given Hyatt Roller Bearings a priceless reputation among builders of industrial, agricultural, mining and transportation equipment.

Sturdy, smooth rolling Hyatts produce unheard of power savings while avoiding production interruptions—while minimizing maintenance—while banishing the need for bearing replacements.

Years of unwavering bearing satisfaction is Hyatt's contribution on any assignment. In some applications Hyatts have recorded 37 years of flawless performance. Their overwhelming preference has been a matter of course—of recognition.

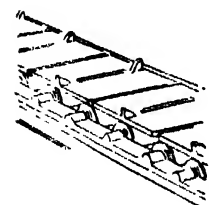
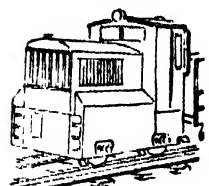
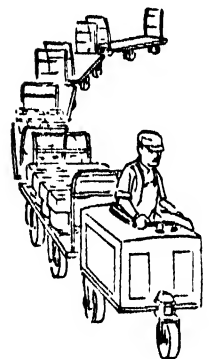
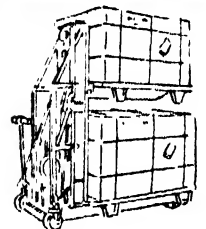
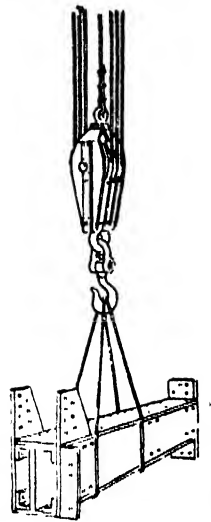
No other bearing can give service so smooth, so lasting, so economical. Small wonder that all industry is turning to Hyatt for permanent bearing performance.

HYATT ROLLER BEARING COMPANY
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HYATT

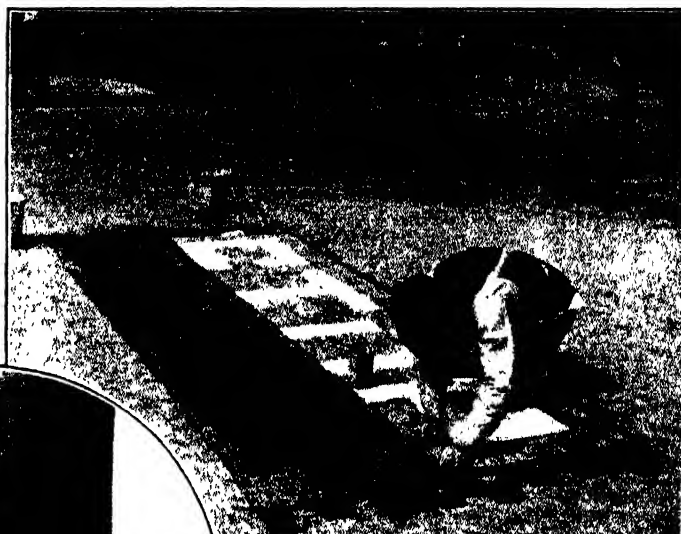
ROLLER BEARINGS

PRODUCT OF GENERAL MOTORS

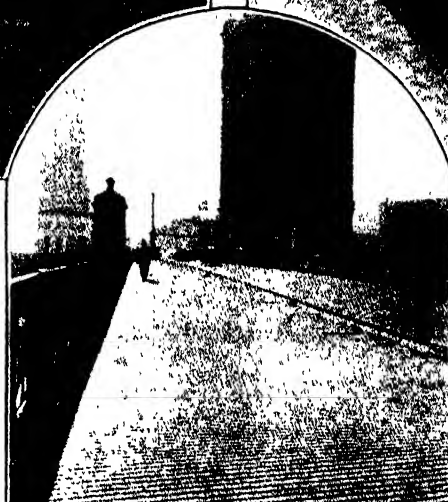




Chemists have successfully developed a rubber paving material which gives promise of wide application in the future. The above view of a Los Angeles store front shows the first colored marbelized rubber sidewalk laid in the world. The rubber chemists matched the marble used in the exterior of the building, providing a paving which is not only attractive but is said to be serviceable



Above: Signs on pavements required repainting so often that experiments with colored rubber tiles were conducted. The "stop" sign shown has been in service for four years and is still in perfect condition. Left: Everyone who walks across the Michigan Avenue Boulevard Bridge in Chicago has all the advantage of rubber heels, even if he hasn't got them. A special rubber pavement is the answer



of over 6000 dollars by the use of ordinary household washing machines in washing soiled wiping cloths, towels, et cetera, that are used in its own factory. Four machines with one attendant, make this saving possible.

Prior to the installation of their present washing system, the factory discarded all wiping cloths as soon as they were soiled, using an average of eight bales of cloth a month, having an average weight of about 700 pounds each. At a cost of about 14 cents per pound, this represented a yearly expenditure of about 9700 dollars. Now this rag consumption has dropped to an average of two and one half bales per month, or a yearly cost of about 3000 dollars. Special check-ups have proved that many of these ordinarily cheap "wipers" have been re-washed and re-used 16 times. Better grade rags have been washed as many as 40 times and look good for 40 more washings.

Washroom towels, hospital uniforms, et cetera, previously were sent to a commercial laundry at an average yearly cost of 900 dollars. These pieces are also laundered in the factory now. Total savings (900 dollars on laundry work plus 6700 dollars on rags) is 7600 dollars yearly. Total washing cost including depreciation on washing machines, salary of workman, gas and floor space, 1155 dollars. Net saving, 6445 dollars.

Rubber Would Lengthen Usefulness of Chewing Gum

THERE is no salvaged rubber from discarded heels or worn-out inner tubes in the chewing gum one gets from slot machines; nevertheless the millions of Americans who daily exercise their jaws are putting a certain amount of rubber into the gum through the process of mastication.

"Five percent of chewing gum," Dr. W. L. Semon, an authority on rubber told the Institute of Chemistry recently, "is rubber. A wad, after chewing, weighs only

about one fourth of what it did before. For in the mastication, sugar, dextrine, and other ingredients are dissolved.

"If you ever get a slice that just crumbles in your mouth, blame science and oxygen," said Dr. Semon. "Chemistry has not yet found a good anti-oxidant which is non-toxic. When it does, the life of a piece of gum may be extended for many more years."

High Pressure Gas Storage Extends Service Radius

WHEN motoring through the "open spaces," we are accustomed to observing the lines of steel towers bearing high voltage wires which make possible the economical transmission of power over great distances. Behind this distribution system lies years of development work, in

which chemists as well as electrical engineers contributed their bit to the complex problems involved in thus harnessing the giant. Less familiar, as yet, are the visible evidences of the same trend in the distribution of manufactured gas, yet the technical men of the gas companies are also developing high pressure distribution systems in order that homes and factories remote from the gas plant may be assured of an unfailing supply of gas for industrial fuel and home cooking, heating, refrigeration, et cetera.

Shown in the accompanying illustration is a type of tank for the storage of gas under high pressure which is beginning to dot the countryside and which may soon be a familiar sight along the nation's highways. This spherical gas holder is known as the Hortonsphere, named after Mr. Horton, one of the owners of the Chicago Bridge and Iron Works. It is a truly spherical steel shell, built up of riveted sections. In cylindrical tanks it has been found that



Washing machines salvage wiping cloths in large factory

welded tanks are superior to riveted tanks but as yet construction difficulties make a welded sphere a doubtful proposition due to the thickness of the plates. A sphere, 10 feet in diameter of five sixteenths inch plate, with all seams welded, has been erected for tests being carried out at the University of Illinois. These tests will extend over a long period, but the tank will eventually be tested to destruction.

The maintenance of Hortonspheres or any type of high pressure storage is less than that of the familiar low pressure holders. The heavy sheets of high pressure storage are less affected by rusting than the lighter sheets of low pressures. There are



"Hortonsphere" gas tank for high-pressure distribution in Indiana

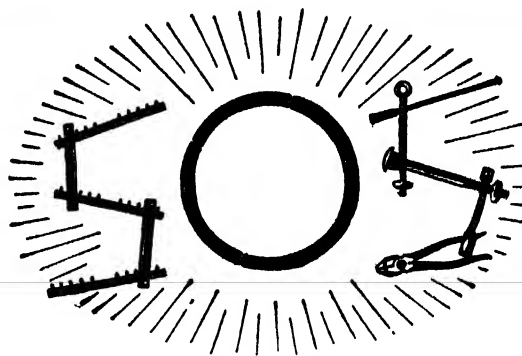
fewer contacts between framework and structure and fewer joints, which means fewer weak points. For the same volume of storage less paint is required for the high pressure holders. The painting can be done under better conditions and the resulting surface is less affected by conditions of operation. In the winter time there is no cleaning of snow from the crown sheets and no water to be kept heated.

Firing Furnaces to Reduce Smoke Increases Efficiency

"WHERE there's smoke, there's fire," but that fire is not burning its fuel efficiently. The chimneys of large buildings or apartment houses are often serious offenders in emitting objectionable smoke, or at least they are more noticeable because of their prominence and because they are usually in locations where there are no factories. The large heating boilers attached to such chimneys are often operated by firemen who are not too well trained and who find it difficult to fire the customary simple type of furnace.

That a reduction of the smoke emission can be obtained without additional fuel cost, and with a lowering of it because of better efficiency, has been illustrated by recent tests conducted by United States Bureau of Mines Engineers with a large heating boiler. In the first series of tests the furnace construction was of the simple grate type suitable for burning coke or smokeless coal. When using bituminous coal and giving the boiler such attention as might be expected in service, it was not possible to prevent the emission of ob-

(Please turn to page 377)



—a signal with a double meaning

S.O.S. - flashed from out of some sea disaster sends its tragic appeal to "Save Our Souls."

S.O.S.—in France with Pershing these letters meant a prompt and thorough Service of Supply backing up the front lines.

Here in America today the business of telephone manufacture and distribution too has its S.O.S.—the prompt service of supply with which Western Electric backs up the nation's telephone companies.

The emergencies, when fires, floods and storms threaten to cripple telephone service, are a part of the day's work, and are anticipated and provided for by previous planning in building up reserves of equipment in a nation-wide chain of 33 distributing houses.

And then there is the greater, though less spectacular, every-day job of providing the sinews of telephone service for the nation—a service of supply challenging comparison in efficiency and cost.

Thus as distributors, and also as manufacturers and purchasers for the Bell System, Western Electric finds its adventures in many fields.

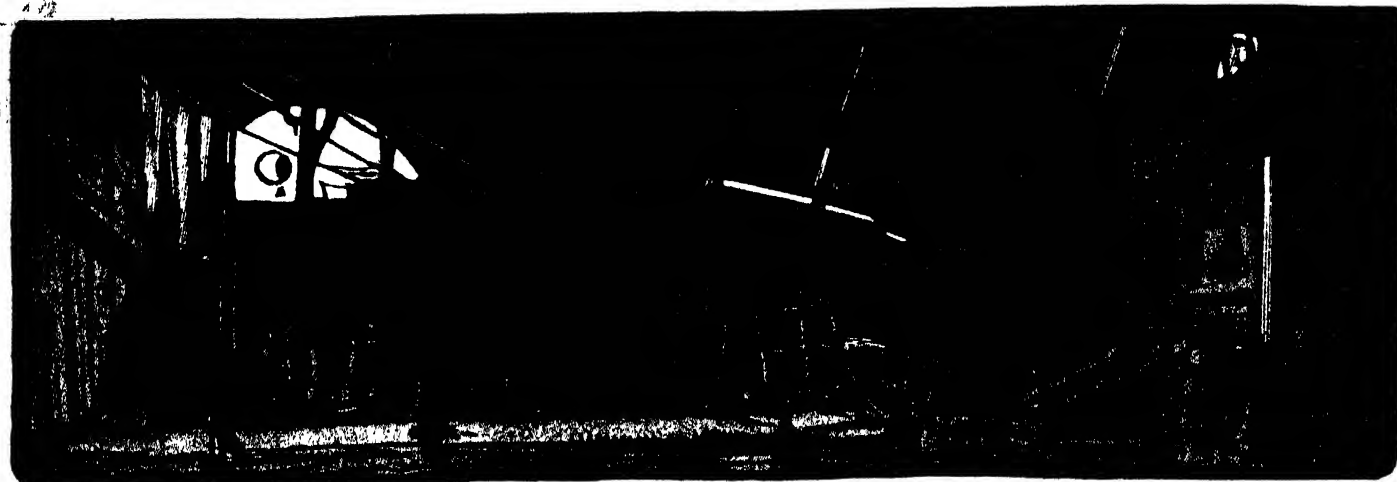
All to serve you when you raise your receiver off the hook!



Western Electric

Purchasers.. Manufacturers.. Distributors





The Back Yard Astronomer

A Department Devoted to Interests of the Amateur Telescope Maker

WHAT kind of a telescope can a man make who lives in a city house where workshop facilities are cramped and limited? Hugh G. Boutell, 3723 Jocelyn St., Washington, D. C., has made a telescope without a single piece of lathe work. We will let Mr. Boutell describe it.



Mr. Boutell and his wooden telescope

"The readers of the 'Back Yard' may be interested in the accompanying photograph and description of my reflecting telescope, made according to the directions in the excellent SCIENTIFIC AMERICAN handbook, 'Amateur Telescope Making.'

"I obtained my glass disks and abrasives from John M. Pierce of Springfield, Vermont, and in this way got just what I needed in the shortest time and with no bother at all. Making the mirror occupied my evenings for about three weeks. As a post on which to mount the tool I used a heavy chest with the handles removed. The chest was placed on end on the cellar floor and loaded with a big chunk of concrete. This formed a very rigid support of smaller dimensions than the barrel usually recommended for this purpose. Also, it brought the tool to just the right height from the floor for convenient working, which seems to me to be an important point.

"Every stage of mirror making is interesting, but the testing by Foucault's method is particularly fascinating, and gives one a new insight into the accuracy of physical measurements, without the use of any of the complicated costly laboratory instruments.

"The mounting was made almost entirely of wood, which is comparatively cheap and can be worked with only a small number of hand tools. The tube was made of one-half inch white pine, six and one half inches square inside. The bottom of the tube was made of two pieces with the grain crossed. This forms the cell for the mirror. The diagonal is a one-inch prism carried in a tin support, and this with the adapter tube is removable as a unit, since both are carried by a block of hard wood which is attached to the telescope tube by bolts and wing nuts. The holes in the block are somewhat large, so that a certain amount of adjustment can be made in lining up the mirror, prism, and eyepiece.

"The telescope is carried by an equatorial mounting made by assembling small

pieces of one- by four-inch maple. The mounting is very solid, being put together with countersunk screws and glue. The axes are one-half inch lag bolts with washers and wing nuts. The use of this type of built-up mounting avoids the necessity of buying any large blocks of hard wood which are more difficult to work. The axes are well greased and the motion is smooth.

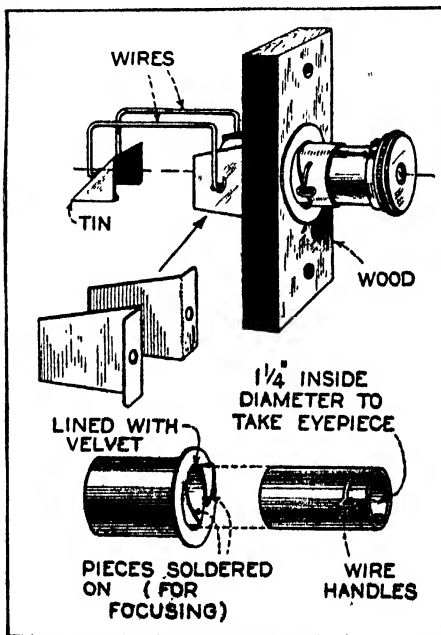
"The setting circles are made from four



Optical glass is made at only two places in the United States, one of which is the Bureau of Standards. Before the World War, America made none at all. The watch is seen through nine inches of this American-made product

five-inch metal protractors such as are used in drafting work. The cross-bars were cut out and the graduated arcs soldered to circular pieces of tin. These circles answer very well for rough work.

"The mirror was silvered by Brashear's process, and strangely enough this proved to be one of the most difficult parts of the entire job. However, the technique was finally mastered and a good heavy coat of

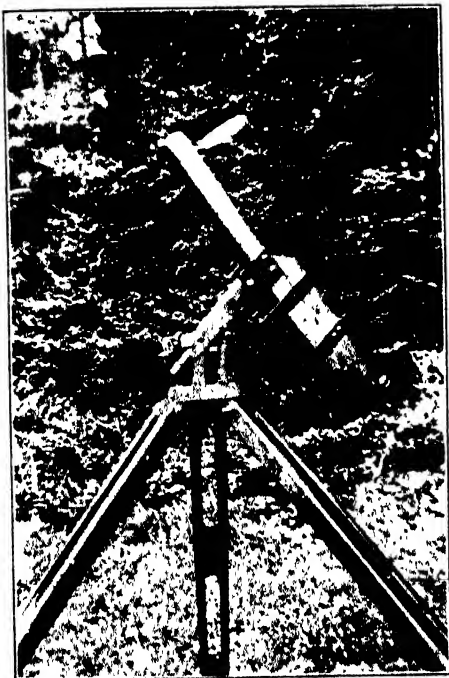


Eyepiece and prism assembly—Boutell

silver obtained on the face of the mirror.

"The total cost of the telescope was not far over 25 dollars, and the performance, for a first attempt, exceeds my expectations. The light grasp is astonishing to one accustomed to very small refractors, and the complete absence of chromatic aberration is a great advantage. The picture which even this little instrument gives of the magnificent Orion nebula with the beautiful little stars of *Theta Orionis* nestled in the midst of the silvery haze will not be soon forgotten by anyone unacquainted with the wonders of the heavens."

Mr. Boutell comments on the height of the post used during grinding and polishing. Many amateurs use too low a post, and thus they acquire an advanced case of the "wash-tub bends." For comfort the



Mr. Clish's simple refractor

top of the mirror should come about on a level with one's floating ribs. It is also possible to sit down at the work.

A. R. Clish, 71 Winter St., Portland, Maine, sends in a photograph of a simple refractor he recently assembled. Although he makes no mention of a crown and flint lens for the objective or of the rather exacting calculations involved in designing such a lens, he states that his telescope functions well enough to gratify him. This is what he writes:

"For the past two years you have published each month the description of a home-made telescope. Most of these descriptions have mentioned the long time necessary to grind and polish the mirror. I am a student at a normal school, having neither time nor facilities to make such instruments. I set out to design a telescope simple enough for my troop of Boy Scouts to use when they wished.

"I asked a local optician to make a lens for me. I suggested that he do it in his spare time, and that it would be an experiment on his part to see if he had the ability to do it. He made me a very good lens three inches in diameter, having a focal length of 24 inches. The lenses for the ocular had me stumped for a time but I happened to think of the lenses in the finder of a camera. I got three of them (Please turn to page 370)



Art— and Wire Rope

From the moment a "cut" of stone leaves its quarry bed until it graces some beautiful building, wire rope is its "motivating force."

And when the quarryman, stone cutter or builder is mindful of his own best interests, Yellow Strand Wire Rope will usually be found "on the job".

Yellow Strand is the highest of high grade wire ropes. Its wire is of Swedish stock and drawn abroad to the most exacting specifications. This super-wire is "laid up" into rope by one of the oldest wire rope manufacturers in this country. Yellow Strand's economy is as distinctive as its "strand of yellow".

This company also makes all standard grades of wire rope for all purposes.

Motorists

You need a Basline Autowline in your car for emergencies. Made of 1/4-inch Yellow Strand wire rope with patented snap hooks for quick attaching. Very strong but small enough to coil flat under a cushion. Ask your accessory dealer.

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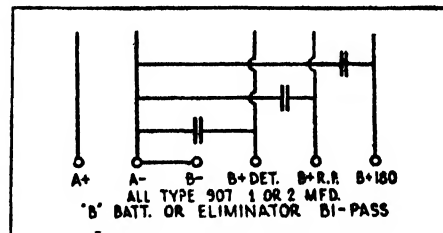
Strays From the Ether

(Continued from page 360)

of variable resistance may be inserted in the plus "B" lead. In this way, the effective plate voltage may be carefully regulated to the best value for the particular tubes employed. This resistance may also be used for a volume control when listening to local stations, and it does not have the disadvantage of broadening the tuning. The resistance should be shunted with a one half microfarad fixed condenser.

Why By-Pass Condensers?

SEVERAL years ago the Dubilier engineering staff recommended by-pass condensers across the plate supply of audio-frequency and radio-frequency circuits,



How by-pass condensers are connected to the power supply source

after an exhaustive study of the action of by-pass condensers. The idea was not received with much enthusiasm at the time, being looked upon as the making of a mountain out of a mole hill. Today, however, when volume and tone quality are considered of paramount importance to meet the requirements of the critical radio ear, by-pass condensers are widely employed in most manufactured and home-built receivers, whether socket-power or battery operated.

In the case of the "B"-eliminator, the use of by-pass condensers for the various plate circuits improves the overall filter action of the "B"-power unit and decreases the hum or ripple to the vanishing point.

When "B" batteries are employed as the source of power, the by-pass condensers act as low impedance paths and prevent audio-frequency regeneration which makes its presence known by howling or again by the so-called "motorboating." In any event, the use of by-pass condensers invariably leads to improved volume and tone quality.

Because of the fairly low voltage handled, with the exception of the by-pass condenser shunted across plus "B" maximum and minus "B," low voltage condensers may be safely employed, of one or two microfarads capacity.

Radio Unsuccessful for Police

SOME time ago, the New York City Police Department purchased over 100 radio direction finding sets at a cost of about 15,000 dollars. Exhaustive experimental work has shown that under the plans originally laid down, the sets are unsatisfactory for the required work.

Ten Commandments for Good Tone

1. Tune in on signals of sufficient strength, from a good broadcasting station. That is the foundation of good tone quality.
2. Employ the best possible amplifier,

capable of the necessary amplification without distortion.

3. Use tubes of sufficient capacity to handle the "wallop," particularly for the last or power tube.

4. Have ample "B" or plate voltage and current available for the various tubes, so they may work at their full capacity at all times.

5. Employ the necessary "C" battery or grid biasing for all tubes requiring same. A variable resistor will provide the precise balance between plate voltage and grid biasing needs.

6. By all means procure the best type of loudspeaker for your set. It is sometimes wise to try out several types until the one that matches your amplifier best and pleases your ear most, is found.

7. There should be some form of volume control, for a set without a volume control is like an automobile without a steering wheel. Use a clarostat across antenna and ground binding posts.

8. And in addition to volume there should be a tone control, in the form of a variable resistor across the secondary of the first audio transformer, or, better still, a variable resistor and one fourth microfarad condenser in series across the amplifier output.

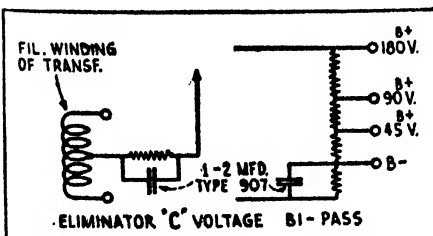
9. Experiment with various locations for the loudspeaker until the best results are obtained.

10. Always adjust the cone-type speaker driving pin, with the speaker silent, to compensate for weather and temperature changes before starting a program.

By-Passing the Grid Bias Resistance

IN most instances where a resistance is employed for the purpose of obtaining "C" bias or "C" voltage, no by-passing condenser is employed. This is an important oversight, since audio-frequency currents must pass through this part of the tube circuit, with the resistance offering serious opposition to their flow because of straight resistance and, in the case of wire-wound resistors, the inductance or choke-coil effect as well. In fact, there is an appreciable loss of volume and tone quality in the absence of a by-pass condenser.

The engineering staff of the Dubilier Condenser Corporation has made a study of by-pass condensers for grid-bias resistances, which forms the basis for the present suggestion. In the accompanying diagram will be noted two typical grid



"C" voltage resistances should always be by-passed, as shown

biasing schemes, with by-pass condensers properly applied. Because of the low voltage-drop in such resistance circuits—generally not more than 80 volts—a low-voltage condenser of one or two microfarads may be employed with satisfactory results. There will be a marked improvement in volume and tone when a by-pass condenser is shunted across any grid bias resistance.

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Controlled heat? Exactly that! A healthful, even temperature when you want it—where you want it—as long as you want it! For the cottage or the mansion. You want your home heated to 70 degrees? Then 70 it is. Not 68 or 72, but 70! Without so much as a glance at the thermometer on your part!

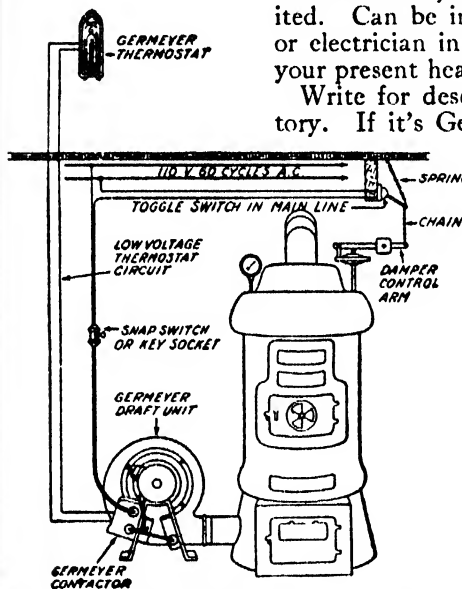
And here's the surprising thing. Burn ANY fuel (except oil or gas) and do it far more economically the Germeyer way.

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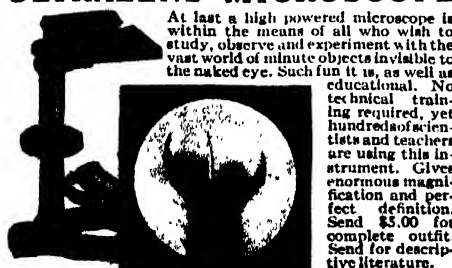
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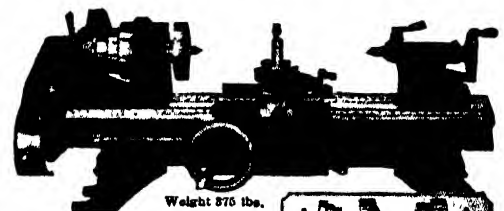
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The Back Yard Astronomer

(Continued from page 367)

from a camera repair man for only 15 cents.

"I had a ring of brass made to hold the objective. Quarter-inch brass works nicely. This was attached by means of a right angle of brass to the heavy (one by two inch) wooden beam of oak.

"The eyepiece tube was made of a piece of one-half inch pipe and a cap to fit, both of brass. A four-inch piece of pipe is long enough. A hole is drilled in the center of the cap, to finish the eyepiece. The lenses are put in the cap, one on top of another, and pieces of sealing wax hold them in very well."

Mr. Clish next describes his mounting, details of which are, however, made sufficiently clear in the photograph. The eyepiece is attached to a piece of wood which slides on the main bar, and is held in place by means of two metal guides.

"The tripod," Mr. Clish continues, "is easily made from stock one and one-fourth by three-fourths of an inch. My instrument magnifies about 80 diameters. I can see four of Jupiter's satellites. The mountains on the Moon show up very well. I can count about 60 stars in the Seven Sisters. I am certainly glad that I built the telescope. It has given me much pleasure."

—A. G. I., Tel. Ed.

The Heavens in October

By PROF. HENRY NORRIS RUSSELL, Ph.D.



At 11 o'clock: Oct. 7.
At 10 $\frac{1}{2}$ o'clock: Oct. 14.
At 10 o'clock: Oct. 22.

At 9 $\frac{1}{2}$ o'clock: October 30.

The hours given are in Standard Time.

At 9 o'clock: Nov. 7.
At 8 $\frac{1}{2}$ o'clock: Nov. 16.
At 8 o'clock: Nov. 23.

NIGHT SKY: OCTOBER AND NOVEMBER

MERCURY is an evening star until the 24th and a morning star afterward. He is, however, too near the Sun to be seen except at the beginning of the month when he may be glimpsed low in the twilight just after sunset.

Venus is likewise an evening star, but being far brighter than Mercury, should be equally visible. On the 1st the two planets are in conjunction, Mercury being $8\frac{1}{2}$ degrees south of his brighter neighbor.

Mars is in Gemini and rises about 9:30 P.M. He is still some 80,000,000 miles away but is rapidly approaching us and growing brighter. He already exceeds all the stars but Sirius.

Jupiter is in opposition on the 28th and is visible all night long. He is near perihelion and his distance from the Earth, 370,000,000 miles, is about as small as it can be. This makes him unusually bright—

more than twice as bright to our eyes as Sirius. His position in the sky in Aries, far from any bright star, makes him the more conspicuous.

Saturn is in Scorpio and is an evening star setting about 9:00 P.M.

Uranus is just past opposition and well placed for telescopic observation; while Neptune is a morning star rising about 2:00 A.M.

The Moon is in her last quarter just after midnight on the 6th; new at 11:00 A.M. on the 13th; in her first quarter at 4:00 P.M. on the 21st, and full at 6:00 P.M. on the 28th. She is nearest the Earth on the 1st, farthest away on the 17th and at her nearest again on the 30th. During the month she passes by Jupiter on the 1st, Mars on the 5th, Neptune on the 9th, Mercury on the 15th, Venus on the 16th, Saturn on the 18th, Uranus on the 26th and Jupiter again on the 28th.

The Scientific American Digest

(Continued from page 352)

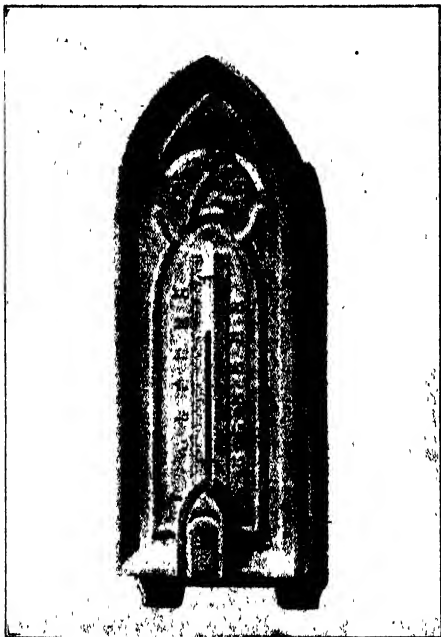
and has a platform supporting a light steel bridge which extends to the bank.

Since there is no railroad near the power house end of the dam, and the cost of a highway connection would be prohibitive, it was decided to have the machinery delivered by barges. A gantry crane of 15 tons capacity which travels on the walls of the building, was therefore erected for handling the machinery, and for future repairs or replacements. With this arrangement, material is picked up from barges, carried to the proper position and lowered through roof hatches into the building. This crane also carries a rake for clearing the trash racks.

The designing and engineering supervision of the construction of this plant for the Kentucky Hydro-Electric Company was in charge of L. F. Harga, consulting engineer of Chicago, and the general contractor was the L. E. Myers Company of Chicago.

Ingenuous Furnace Control

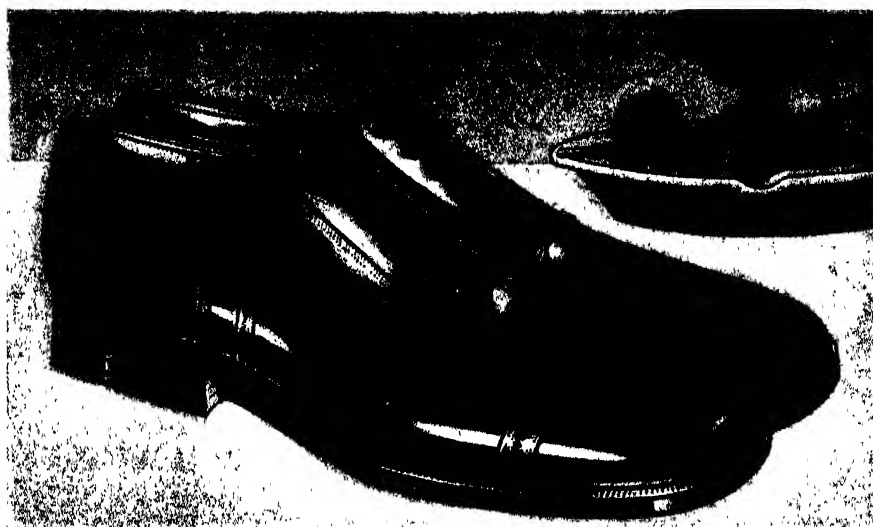
ONE of the essentials of present day comfortable living is a positive automatic control for the furnace. There are many devices on the market which accomplish this work, but it is interesting to note one in particular which has a number of well-conceived features. This arrange-



Exterior of the thermostat of the furnace control showing thermometer and the setting pointer

ment, illustrated in these columns, is the product of the Germeyer Engineering Company. It consists of an electrically driven air blower, an automatic thermostat, and a contactor which in itself is unique in design and construction.

Two different types of motors can be obtained for use with this installation: one of variable speed and the other of constant speed. The motor driven blowers will deliver a maximum volume of 250 cubic feet of "free air," of about 225 cubic feet against one inch static pressure, while the shut-off pressure is about $8\frac{1}{2}$ inches. Because of the special construction of the motors, there is practically no possibility of



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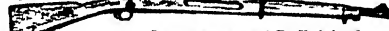
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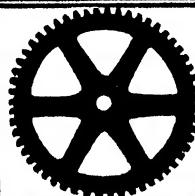
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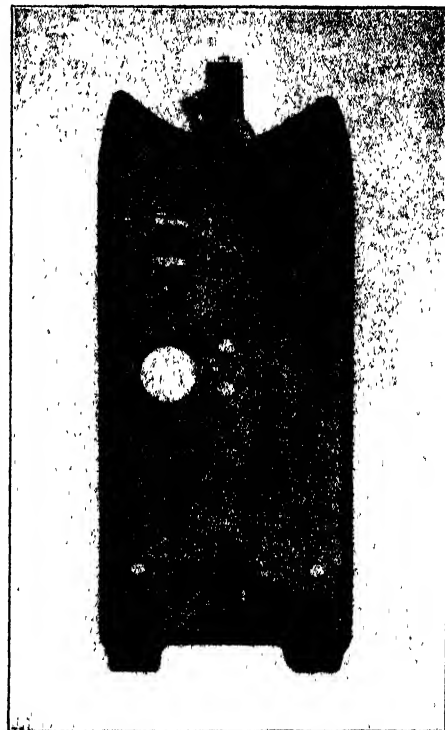


Mechanical contacts on machines in the shop make and break the electrical circuits which operate the counters over your desk. Your regular lighting circuit supplies the current (Also counters to operate on storage battery). Write for our green book of Counters for all machines and development-work.



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interference with radio due to sparking. The thermostat employed is extremely simple but it has a magnetic arrangement which is worthy of mention. A permanent magnet sets up a constant field around the crescent-shaped contacts. When these



Thermostat showing crescent-shaped and arm contacts—open

contacts are almost closed due to a reduction in heat, the magnetic field causes them to close the remainder of the distance quickly, thus insuring a firm contact. Likewise, as the room heats up and the thermostat tends to open, the magnetic field holds it closed until the thermostat arm has stored up considerable spring energy; then when the contacts are released, they spring



The combination transformer and relay with its binding posts

apart quickly, eliminating any possibility of an arc.

The contactor employed is a combination transformer and relay. Two coils are wound on a "U" shaped core and placed beside them is a resistance coil wound on a bobbin. This resistance is in series with one coil and with the current supply line. Thus a magnetic flux is generated and the arma-

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ture is attracted to the pole piece. When the thermostat contacts close, a current flows in the other coil on the "U" shaped core, partially counteracting the flux set up by the other coil. This action releases the armature and closes the main contacts to the motor circuit. No batteries or other source of current supply than that which supplies the motor, is necessary with this furnace control apparatus.

The draft unit has an automatic damper on the inlet, which closes when the blower stops. This prevents air from being drawn in by natural draft and the resulting overheating of rooms; it also makes possible the use of any kind or size of coal and of coke, and prevents waste of fuel.

This automatic control may be installed on any type of heating system and regulated at any convenient part of the house by means of the thermostat.

Special Process of Chromium Plating Resists Heat

INQUIRIES continue to reach us concerning the protective value of chromium plating. Recently a correspondent wanted to know if chromium might be applied to wire fencing which was subjected to the menace of brush fires, et cetera. It is generally known that galvanized fencing, after once being burned in a fire of this kind, or bent and turned by farm implements, rapidly rusts and, in time, fails entirely.

A report we have recently received states that chromium can be applied to wire fencing at a cost of only about 100 percent more than that of ordinary galvanized wire. The report is as follows:

"By use of Madsenell coating methods, an absolutely tight coating of nickel, chromium, or zinc is obtained. In ordinary methods of coating, nickel is put on copper and then chromium on top of the nickel. Where any heat resistance is needed, these coatings peel readily from the steel.

"Madsenell coated sheets and wire have been tried in an enameling furnace which is constantly maintained at a temperature of 1600 degrees for as much as 500 hours and with this very severe test, the coatings have never peeled and were only slightly oxidized.

"The cost of nickel and chromium coated wire would be 100 percent more than the ordinary galvanized wire which rusts out in a very short time and will not stand any great amount of heat."

Industrial Use for Cottonseed Hulls

COTTON and cotton products are used for many and varied purposes, and now a unique use for cottonseed hulls—usually utilized for cattle feeding—has been developed.

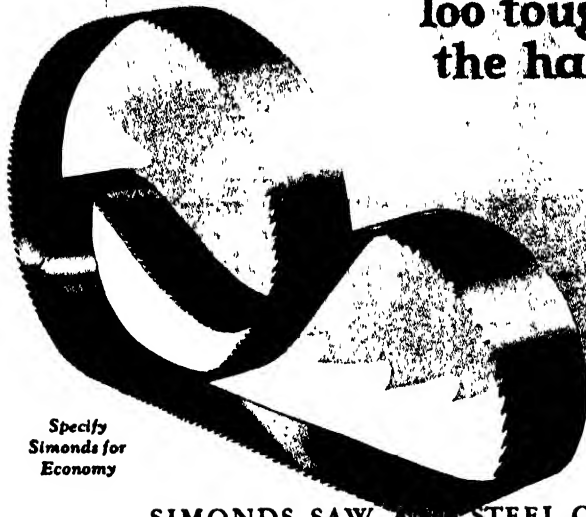
Hundreds of new oil wells have recently been drilled in the fields of west Texas, in Crans, Pecos, and Winkler counties. A big problem in the drilling of wells is that of side-wall caving before the casing is set in the wells. Recently it has been discovered that a few tons of cottonseed hulls poured in a well, at about the depth of possible caving, will prevent caving as drilling continues. Moisture expands the hulls and this, combined with the force of the drill, forces the hulls to the side-wall in a tightly compacted mass which stops the caving tendency, thus saving a great deal of time and money.

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Learning to Use Our Wings

(Continued from page 356)

motorcycle until flight started. Glen Curtiss, another great pioneer, built the first flying-boat glider in 1922, with which some glides were made at Port Washington, a fast motor boat being used for towing.

Outside of these rare attempts, gliding in the United States is conspicuous by its absence.

This year, it is encouraging to learn, the American Motorless Aviation Club has been formed, mainly by the efforts of J. C. Penney, a young American sportsman. This club has brought over three young German pilots, Peter Hesselbach, Captain Paul Roehre, and Dr. Paul Laubenthal. With these pilots came three gliders, one of which is similar to the famous Darmstadt glider, which holds the world's soaring flight record of 14 hours 23 minutes, and the world's altitude gliding record of 2715 feet.

A serious attempt is to be made to overcome the great handicap to American gliding, namely the absence of suitable topographical and meteorological conditions near the great centers of population. The successful endurance glide is not a mystery. Sustained gliding is possible only when there is available a steady and fairly powerful upward current, which allows the glider to perform a steady downward glide relative to the air, while it remains parallel to the earth, or even climbs. Aerodynamic efficiency of the glider and the utmost skill in piloting are of no avail if these basic conditions are not found.

After much searching, the American Motorless Aviation Club selected Corn Hill, near Provincetown, Massachusetts, as an ideal location, where a hill that forms a continuous ridge, and sea breezes a promise of steady upward currents.

Paul Hesselbach has been selected as the first man to try to break the endurance record in the glider. His attempts will apparently not be without some danger. Corn Hill not providing a satisfactory breeze, the glider was transported to Highland Light on the ocean side of Cape Cod. At this point there is a precipitous embankment of 1400 feet sheer drop. Hesselbach's glider was placed near the edge of the cliff and catapulted by 10 men manipulating a rubber "slingshot." The wind was not strong enough to sustain the glider after it was catapulted, and it settled dangerously near the edge of the cliff. Only a skilful tilting maneuver prevented a dangerous fall over the edge. We hope that ensuing attempts will be more successful.

It may be of interest to our readers to review the present status of glider construction as it has developed in the many German meets. Apparently gliders have now evolved into three distinct classes, as demonstrated by the Rhön-Rossiter meet of 1927.

There is first of all the "school" glider, the purpose of which is to give the pilot his initiation into the art of gliding. In such a glider, aerodynamic refinement may be largely dispensed with. It should be, above all, inexpensive and easily repaired after being damaged in poor landings.

All the school gliders are high-wing monoplanes, with skeleton fuselages. The pilot's seat under the wing is entirely unprotected and has no obstruction in front of it. This type of construction is said to lessen the liability of injury to the pilot by splinters

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in the event of a crash. Also, since the pilot has no reference line to fly by, this type of glider has value as a means of training to fly by feel. A pilot after flying such a glider would know how to act even when deprived of adequate flight instruments. Since aerodynamic advantage is a minor consideration, school gliders have a low aspect ratio, that is, a low ratio of the span or spread of the wing to its chord or width.

In the second class, the "training" glider, a high-wing monoplane is also employed. But the fuselage is now enclosed, thus reducing its resistance. The aspect ratio is still only six to one, but nevertheless these training gliders have made quite long glides in the hands of skilled men. We append line drawings of a typical training glider, which has a span of 32.81 feet and an over-all length of 18.04 feet.

Finally we have the "contest" gliders, in which every effort is strained to develop aerodynamic efficiency. To this class belongs the famous Darmstadt glider. The fuselage is now of perfect streamline shape, with a delicately rounded bow. There are no struts or wires to brace the cantilever monoplane wing. Finally the wings have the enormous spread of 59 feet, with an average chord of something like two and one half feet, giving an aspect ratio of over 20. This is conducive to the greatest efficiency in soaring, but it also means a somewhat heavier weight empty than in the training or school gliders. The Darmstadt glider when empty weighs 331 pounds, which is surprisingly high for a glider.

An Altitude Record

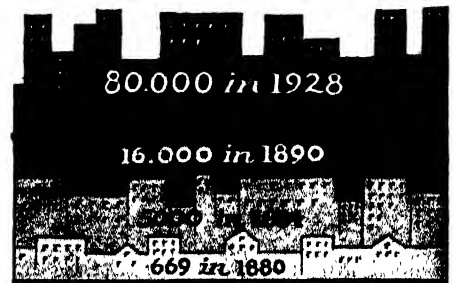
RECORDS in aviation come so frequently that it is hard to keep track of them. Still it is interesting to learn that the Navy flying boat, the *PN-12* has flown to a height of 18,500 feet with the greatest useful load ever carried to such an altitude.

The plane was actually weighted with 4200 pounds of zinc bars. It was piloted by Lieutenant Arthur Garvin. The boat is powered with two powerful Hornet engines, and has the now conventional, but none-the-less beautiful, hull lines, with a sharp bottom line, and a flattened V prow.

Tail Trimming Flap

IN the typical modern airplane, the stabilizer is made adjustable in the air. The front spar of the stabilizer hinges from a support on top of the fuselage, and the rear spar is made to move up or down by means of a threaded bolt and a nut, the bolt being turned by a cable running to a handle in the pilot's cockpit. The adjustment of the stabilizer serves to trim the plane for various load and flight conditions. The provision of an adjustable stabilizer introduces a certain amount of weight and complication. The French Nieuport company has recently patented an alternative trimming gear which has possibilities. The contrivance consists of a pair of narrow, hinged flaps along the leading edge of the elevators. The flaps are controlled by a worm gear and cable. Raising the flap on the upper surface is equivalent to turning the front edge of the stabilizer down. Projecting the flap on the under surface is equivalent to raising the front edge of the stabilizer. The arrangement is certainly simpler than the process of adjusting the entire stabilizer.

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Industries From Atoms

(Continued from page 365)

jectionable smoke. The boiler was then equipped with air control devices. A second series of tests with the changed boiler showed a decided reduction in the smoke produced and an increase in efficiency of from 1 to 4 percent.

The Menace of Increasing Population

(Continued from page 340)

consider the physical difficulties in South America of conquering their river systems, and the political difficulties in Russia and in Asia to be overcome, before dense populations can be there developed.

Thus one sees that migration is not merely a problem of absolute or even of relative densities, viz. of the ratio of existing to possible populations under given conditions, but embraces most complex systems of relation depending upon human characters, states of culture, ideals and development. It is a problem of simple character only to those who have given it no serious consideration.

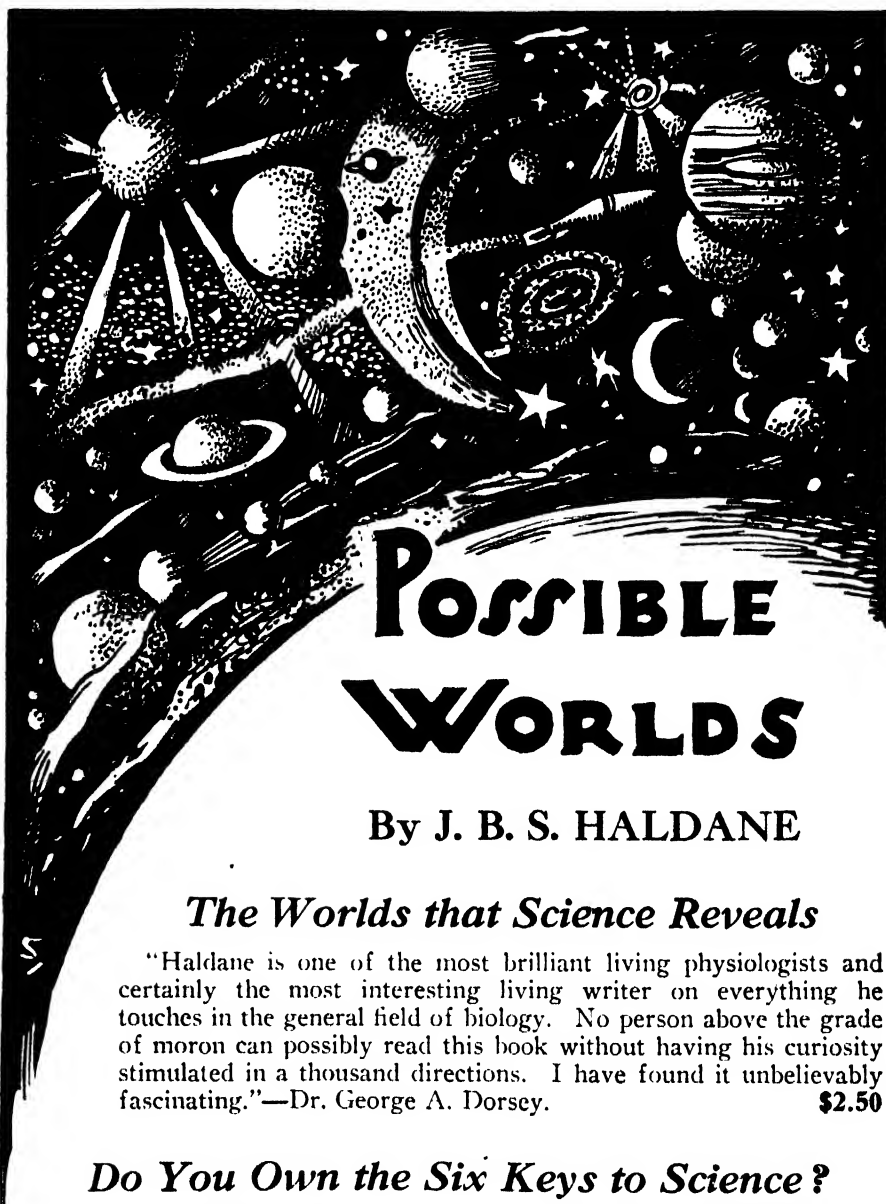
At the same time it is eminently desirable that a commencement should be made by way of ascertaining thoroughly the possibilities of the whole situation. This will take time and will involve world-wide efforts on some definite plan to be mutually agreed upon, if possible. The question involves international difficulties, the nature of which will suggest themselves to any political thinker, and which we cannot discuss here.

To sum up: The rate of population increase; the elevation of our standards of living; the growing rapidity with which our forests, our coal and oil fields, our iron, copper, zinc, tin, and aluminum mines are being exploited; and our increasing difficulties in insuring adequate supplies of food-stuffs, are such as to challenge our attention. Anyone who has any interest in the future of his nation for even the existing century, is called upon to consider the issues of human increase and to recognize that we are faced with a problem of supreme difficulty, a problem to which publicists and economists may well give their profound attention.

An avalanche of trouble threatens; is it to sweep us into appalling disasters? Migrations are merely a palliative, for human reproductive forces perpetually tend to re-establish the pre-existing populations and to increase them. The mere fact that an annual 1 percent increase means an addition of 10,500,000 to the world's people, and that that rate has recently been exceeded, commands our attention.

The 1910-1920 rate of increase for the United States, were it continued to the year 2000, would in the 72 years add no less than 200,500,000 to its population. Such a fact demands that we give it consideration.

If ever we are able to transfer the enormous costs of preparations for war or defence to studies of social economics and to scientific research and its applications to the well-being of man, the load may be lightened. But even then the reproductive urge will tend to re-establish the acuteness of the problem, namely, how may we meet the needs of human increase?



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Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Good to the Last Bite

THE Cheek-Neal Coffee Company has built up a tremendous business in coffee through spending millions of dollars in advertising their trademark "Maxwell House" and their slogan "Good to the Last Drop." The fact that the business was sold not long ago for twenty-seven million dollars is some evidence of the value of the trademark and the slogan. Probably they would be good for some other business, as well.

Whatever its motive, the Hal Dick Manufacturing Company, of Knoxville, Tennessee, applied at the Patent Office for registration of a trademark consisting of a composite picture including the representation of a hotel, the words "Maxwell House" and the slogan "Good to the Last Bite." This mark they are using for horse-radish, olive spread, cranberry jelly and a large number of similar goods. The Cheek-Neal Company opposed the registration, but First Assistant Commissioner Kinnan allowed it, stating, however, that registration would have been refused had there been any element of doubt in the case. He said:

"The applicant's goods are in no sense beverages as are the tea and coffee sold by opposer, but belong to the class of salads and relishes, and it is believed there is no warrant for holding the goods of both parties possess the same descriptive properties or belong to the same class, as such terms are used in the trade and have been interpreted or construed by the courts in previously adjudicated cases. While not unmindful of the fact that the registration of opposer's mark by others upon different classes of foods tends to destroy the distinctiveness of opposer's mark and to an extent may be said to damage opposer, yet, under the statute, the only ground upon which refusal of registration to such applicants can be based is that the goods possess the same descriptive properties.

"In the case of American Tobacco Company, Inc., versus Gordon, the Court noted that merchandise possesses the same descriptive properties in a statutory sense when the general and essential characteristics of the goods are the same, and noted that the 'statute must be taken as it is found.' It seems impossible to hold that opposer's coffee and tea belong to the same class as the relishes and salads upon which the applicant applies its mark, and since this is the only statutory basis for sustaining the opposition, the opposer must fail."

The Fountain Pen Invention

WHO is the inventor of the fountain pen?

Lewis E. Waterman?

No, indeed. He was a late comer in the field when he applied for a patent September 19th, 1883. King Tutankhamen's secretary probably had been using one long before Waterman.

Excavations in an Egyptian tomb dating back more than 4000 years, according to

the *Journal of the Patent Office Society*, shows an early form of fountain pen. The primitive instrument consisted of a section of reed of the diameter of a lead pencil, about three inches in length and mounted on a long piece of copper. The nib of the pen was cut away to a fine point like an ordinary quill pen. The narrow tube of the reed served to hold in reserve a small quantity of the writing fluid, whatever it may have been.

The earliest writing fluid, it is now thought, was probably applied by means of a brush in Egypt and in China. The brush required frequent dipping into the fluid, which may have led to the idea of a

Waterman's invention provided an ink duct with longitudinal fissures in the side, the gradual decrease in the size of the tube toward the nib providing against the excessive flow of ink. The groove being in direct contact with the pen, a sufficient quantity of ink was supplied. Waterman, by the way, used ordinary pen points which he bought from other manufacturers. Soon after he obtained his patent he assigned it to his wife. She then leased the exclusive manufacturing rights to him, in return for which he paid her a royalty of 25 cents per pen.

Monopolies on Narrow Inventions

IT is by a very narrow margin indeed that some devices are called inventions and are granted patents. The Walten patent for an automobile tire flap is probably as narrow an invention, if invention it be, as any that has been issued, and yet the Court of Appeals of the District of Columbia has been reversed in its decision dismissing a suit on the ground that the patent was void for lack of patentable novelty.

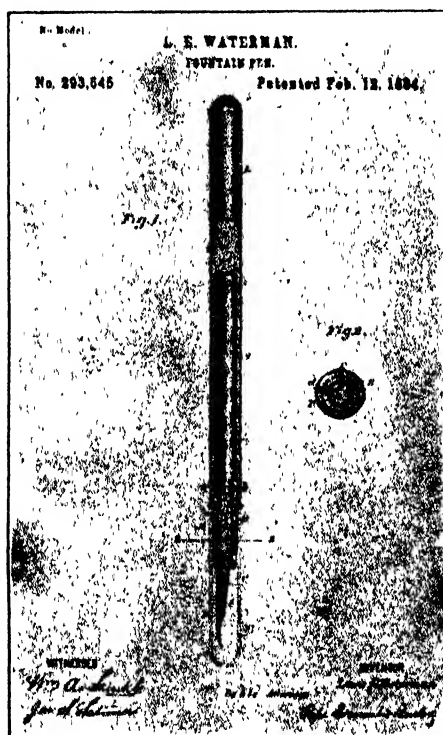
The patented device is a full length tire flap with a perforation at one end to fit over the valve stem of the inner tube and provided with marks showing where perforations for adjustment should be made at the other end. When Tingley and Company, controlling the patent, put the flap with the markings on the market, imitations speedily followed. Suit for infringement was brought against the Badger Rubber Works.

"Because there were five sizes of tires," says Judge Page, writing the majority opinion for the Circuit Court of Appeals for the Seventh Circuit, "it was the practice, and, so far as known prior to Walten, necessary, to manufacture, and the dealer had to carry, a supply of flaps in each of the five lengths. What Walten sought to do was to make one flap that could be easily altered by anyone so that it would not be necessary to manufacture or carry in stock the five sizes theretofore made and carried. Some of the difficulties to be overcome in accomplishing his purpose are pointed out in the application.

"Whether the many millions of automobiles, which we know as a matter of common knowledge have been manufactured during the last 30 years, used with each of their four wheels a tire flap, we do not know, but the number that must have used them is so large that the desirability of reducing the number of tire flaps to be carried in stock we think is apparent. The haste with which appellee adopted Walten's flap is some evidence that the trade approved such a change."

Judge Evans dissents heartily from the decision, declaring:

"Appellants' improvement is in supplying 'indicia for aperturing said imperforate portion to make the flap any one of a plurality of sizes.' In other words, the flap described in the patent is provided with marks which inform the user where he



Reproduction of the drawings accompanying Waterman's patent

pen which would hold a considerable amount of fluid.

By the time Waterman made his invention, fountain pens were so well known that all he claimed was "certain new and useful improvements in fountain pens." He says in his specification:

"My invention relates to that class of fountain-pens in which the nib of the ordinary writing-pen is supplied with fluid ink from a barrel or reservoir, which may conveniently form the handle or holder of the pen.

"The object of the invention is to secure and automatically regulate a certain and uniform flow of ink to the pen, and also to prevent the excessive discharge of the ink when the pen is in use. By my invention a fountain-pen composed of but comparatively few parts is produced, and the general construction of this class of pen greatly improved and simplified."

may cut additional openings in the flap to make it shorter.

"Clearly it would not constitute invention to make places in a belt through which holes might be cut to make the belt shorter. This, it seems to me, is all that Walten did.

"I cannot believe that there was any patentable novelty which can be ascribed to the use of an expedient so simple and commonly used for shortening the usable portion of a belt, strap, flap, or other similar article. What any 10-year-old boy, upon finding his older brother's belt too large, would do with his jack-knife, would hardly be called an inventive discovery."

Inventors Should Be Practical

AN inventor sent to us recently a description and sketch of a device which well illustrates a common fault of amateur inventors—that is, it is not in complete harmony with public habits and tendency. This device he called a "Carry-All." Made of silver or aluminum, it was intended to contain the entire miscellany of articles usually carried in all the pockets of the ordinary man. It can be carried in the inside coat pocket or the hip pocket. The interior included the following compartments:

1. Smoking service: cigar, mouthpiece, match with a relative lighter.
2. Toilet service: mirror, comb, nail file, smelling bottle.
3. Writing service: pen, pencil, eraser and ink bottle.
4. Precision instruments service: watch and compass.
5. Pocket book service: documents, private notes, secrets, souvenirs and bank notes.

For the American rights to the invention the inventor asks 5000 dollars. In our opinion manufacturers probably will not rush to him in great numbers. The average man does not carry smelling bottles, ink bottles, compasses and other things which the inventor has provided for. And when a man reaches for a pencil he wants to find it in his vest pocket and not inside a carry-all in some other pocket. An invention is more likely to win out if it caters to people's habits rather than if it tries to change them. The most successful inventor is the one who thinks and acts like his fellow-men but just a little ahead of them.

The Balloon Tire Patent

THE claims of the famous Putnam patent for balloon tires have been held invalid by the Federal District Court for Eastern Michigan. The suit brought by the Steel Wheel Corporation has been thrown out of court and the B. F. Goodrich Rubber Company is allowed to make its fifty-odd sizes and constructions of balloon tires without molestation.

"Putnam was not the bell cow who led the entire herd and all the different herds along the highway down to the 'balloon' tire barn, with its luxurious beds," says Judge Tuttle, "but was merely one of the many cows who had seen the 'balloon' tire barn in the distance and had journeyed down that way and were gazing around outside of the barn for quite a while before the tire and rim men in charge of the barn opened the door. When the door was

opened the others all went in with a rush.

"The tire industry and the automobile industry have their associations for standardizing tires, rims and devices of that character. That such things should be standardized is for the convenience and for the advantage of the public and is economically helpful to the world. But in an industry which is thus standardized and in

which the decision with regard to changes rests with comparatively few people, changes are apt to take place suddenly when those in control open the door to them."

Judge Tuttle gives an interesting history of balloon tires in his opinion. One of the first to make practical use of the advantages to be derived from relatively wide pneu-

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Pertaining to Aeronautics

SOARING HELICOPTER—Which may be propelled manually and elevated vertically, is provided with foldable wings for soaring, and requires but a minimum of effort for the lifting purposes. Patent 1680175. A. Rudy, 412 McKinney Ave., Houston, Texas.

Pertaining to Apparel

SHOE INNER SOLE—Which is not only a corrective but serves to maintain a good foot in a normal state, and do away altogether with commonly used arch supports. Patent 1677105. B. J. Silver, c/o Milburn Hotel, 242 W. 76th St., New York, N. Y.

SUPPORTING LOOP FOR GARMENTS, ETC.—Of the type formed from a single length of resilient wire, shaped to provide a lower button engaging loop, and an upper strap engaging bar. Patent 1677078. R. E. Garrett, c/o F. J. Schubert, 218 Reidhurst Ave., Nashville, Tenn.

INFANT-NAPKIN PROTECTOR—To be worn by infants to form a protective covering for the usual diaper, which by its form permits the freedom of movement of the limbs. Patent 1680178. Flora M. Shafer, 8159 Lefferts Ave., Kew Gardens, L. I., N. Y.

Chemical Processes

PROCESS OF PURIFYING SUGAR SOLUTIONS—Which consists in heating a sugar solution to approximately 90° C., adding a prolific quantity of lime for decolorization, neutralizing by means of a suitable acid, and filtering. Patent 1678571. F. W. Meyer, c/o G. Hirschfeld, Alexandrinenstrasse 134, Berlin, S. W. Germany.

MEANS FOR TREATING HOLLY AND LIKE PLANTS AND PRODUCTS DERIVED THEREFROM—An apparatus for receiving the holly leaves that they may be treated to produce extracts available as a beverage, or for medical purposes, and the by-product used for cattle food. Patent 1679525. S. M. Hoyer, 594 5th St., Brooklyn, N. Y.

Designs

DESIGN FOR A FINGER RING—Patent 75406. G. Bartiromo, 417 Jewelers Exchange Bldg., Los Angeles, Calif.

DESIGN FOR A ROUGE BLENDER—Patent 75501. Helen Leyne, 5785 Mosholu Ave., Bronx, N. Y.

DESIGN FOR A BUILDING—Patent 75511. G. H. Natzel and F. E. Jackson, Santa Ana, Calif.

DESIGN FOR A LOUD SPEAKER OR THE LIKE—Patent 75554. P. H. Fuller, Lefurgy Ave., Dobbs Ferry, N. Y.

DESIGN FOR A LOUD SPEAKER—Patent 75558. R. Y. Günther, 6034 Hollywood Blvd., Los Angeles, Calif.

DESIGN FOR SHOE—Patent 75681. T. J. Fitz Harris, c/o Franklin Simon & Co., 38th St. and 5th Ave., New York, N. Y.

DESIGN FOR A BOUDOIR SLIPPER—Patent 75757. H. Wilhelm, c/o Bernard Bernbaum, 1440 Broadway, New York, N. Y.

DESIGN FOR A CUFF BUTTON OR SIMILAR ARTICLE—Patent 75807. F. C. Rile, 6022 Calumet Ave., Chicago, Ill.

DESIGN FOR A WALL-PAPER PANEL OR THE LIKE—Patent 75794. H. L. Hoffman, c/o R. E. Thibaut Co., 24 W. 40th St., New York, N. Y.

DESIGN FOR A WALL BRACKET—Patent 75801. C. Lehrman, c/o Levolute Co., 176 Grand St., New York, N. Y.

DESIGN FOR A BOTTLE OR THE LIKE—Patent 75763. R. B. Annis, c/o Mower-Gulden Annis Co., 87 34th St., Brooklyn, N. Y.

DESIGN FOR A COMBINATION BATH FIXTURE—The inventor has been granted two patents of a similar nature. Patents 75819 and 75820. J. H. Balmer, 259 Plane St., Newark, N. J.

DESIGN FOR A COAT—Patent 75826. Katherine E. Burns, c/o Franklin Simon & Co., 38th St. and 5th Ave., New York, N. Y.

DESIGN FOR A STOCKING—Patent 75846. A. M. A. Hoffman, 136 Mineral Spring Ave., Passaic, N. J.

Electrical Devices

INDICATOR SWITCH FOR RADIOCIRCUITS—A signal light, whereby the operator knows whether the circuit is on or off by merely seeing whether the light rays are projected through the hollow switch arm. Patent 1673876. A. C. Koeppler, 4928 Henderson St., Chicago, Ill.

RADIODIAL—Equipped with a visible indicator which becomes active whenever the dial has been rotated to the proper point to bring in a station. Patent 1674603. H. Matzner, 24 Nathan Davis Place, New York, N. Y.

ADAPTER AND PLUG FOR CUT-OUTS—Wherein a specially prepared fuse plug may be used in any ordinary screw socket, the parts being so constructed as to prevent a wrong size being used. Patent 1675637. W. P. Briggs, Municipal Bldg., New Bedford, Mass.

STEAMING IRON—An electric heating element wherein the current passing through water from one electrode to another makes the water flash into steam without the accumulation of water. Patent 1676098. R. Leprestre, 1158 Fifth Ave., New York, N. Y.

MOTOR CONNECTION INDICATOR—Particularly adapted for use in connection with three phase motors, where the windings are connected for current of 220 or 440 volts, and it is desired to reconnect the winding from 440 or 220 volts. Patent 1675019. H. W. Beaver, 1355 Portia St., Los Angeles, Calif.

ILLUMINATED DIAL—Which may be readily applied to the cabinet of a radio apparatus and

matic tires at correspondingly reduced inflation pressures, he finds, was the Palmer Tyre Company, Limited, a British concern whose product was known as the Palmer Cord Tyre. Beginning as early as 1908, the company's literature and trade journals described the increased riding comfort of wide, soft tires, in language that would fit exactly the present-day balloon tire.

Three years before Putnam's patent issued, the Hawley patent had been applied for, December 10th, 1917. It disclosed fully the advantage of a wide, thick, soft tire, which is what Putnam claimed when he filed his application, August 3rd, 1920.

More than a year before Putnam's application was filed, the French patent to Perrot for a balloon type of tire was published. Not only that, but R. K. Mulford had been using Goodyear airplane tires on his small cars in 1917 and 1919, a use which the judge declares is sufficient in itself to invalidate the Putnam patent.

Summing up the entire patent situation, Judge Tuttle says:

"There is not the slightest doubt in my mind as to the value of the 'balloon' tire in the way of comfort, economy, and length of tire life. If we disregard the intermediate steps which have occurred and compare the wide, soft, easy-riding 'balloon' tire of today, with the narrow, highly inflated, hard-riding tire of yesterday, and by 'yesterday' I mean a time far enough back to avoid all contentions and disputes, and all prior uses, prior publications and prior patents in this record, we cannot fail to be impressed with the great practical importance of the advance that has been made. Had that advance been made in a single patent, there could be little doubt of the presence of the inventive genius in that discovery, or of the validity of that patent.

"However, the advance to the 'balloon' tire has not been made in a single step, but step by step, as the industry has developed, and the Putnam patent here sued upon discloses no 'discovery' whatever, but merely what was well known in the art, and repeatedly published during more than a decade preceding Putnam's application date."

Invention as a Remedy for Unemployment

"IN a way, invention, through labor-saving machinery, has caused some of the present unemployment, and in my opinion, new invention is one of the only ways to cure it."

So declared Honorable James J. Davis, Secretary of Labor, recently. The Secretary, of course, does not mean to imply that all labor-saving machinery brings about unemployment. Such a sweeping generality would be just as inaccurate as to say that no invention ever throws men out of work. To how great an extent labor-saving machinery has resulted in unemployment is a matter for theorists to discuss. That the development and manufacture of new products would put men to work is self-evident.

Fortunately, the remedy for unemployment which Secretary Davis suggests already is being applied. Patent attorneys have had a steady inflow of inventors seeking to patent their ideas. This unusual demand for patent attorney services has existed since the first of the year. Within six months it will begin to show an increased volume of patent business issuing

connected to the various parts, without appreciably illuminating the surrounding objects. Patent 17017 (Re-issue). W. C. and F. Buchholz, c/o Frank Buchholz, 87 Penn St., Brooklyn, N. Y.

ELECTRICAL CONTACTOR—In the nature of a clip, to which the conductor wire is so applied that direct contact of the surfaces for radio or lighting may be obtained. Patent 1677059. P. M. Tebbs, 1617 Forster St., Harrisburg, Pa.

ELECTRICAL HEATING AND COOKING APPARATUS—A bendable unit which may be given any desired shape for generating heat so that surrounding fluids, whether gaseous or liquid, may be heated for practical purposes. Patent 1677032. J. W. J. Kaffer, Kerkstraat 81, Meester-Cornelis, Java, Dutch East Indies.

DISPLAY DEVICES—Having a backing which lies flat when collapsed, but can be quickly secured upright, and spaced, for holding an electric light to illuminate a picture. Patent 1677840. L. Moses, c/o Wolf Advertising Co., 45 West 18th St., New York, N. Y.

ELECTRIC LAMP—An incandescent lamp having a concave reflector for directing the rays of light in the manner of a spot light at a considerable distance. Patent 1678606. G. C. Singer, c/o United Land & Irrigation Co., Brownsville, Texas.

ELECTRIC WELDING TONGS—So insulated as to prevent arcing except at the welding electrode, thereby preventing accidental arcing resulting in serious injury to the operator. Patent 1677306. C. L. Stancliff, 2332 Chester Ave., Bakersfield, Calif.

TIME-CONTROLLED CIRCUIT CONTROLLER—An electrical circuit controller capable of being applied to any conventional form of alarm clock without modification of the construction of the clock. Patent 1678217. R. R. Gonsett, 1269 So. Cochran Ave., Los Angeles, Calif.

LEAD STORAGE BATTERY—Of strong construction, having greater capacity for a given volume, and means for permanently sealing the battery. Patent 1678224. A. Kastelic, 311 23rd St., Richmond, Calif.

Of Interest to Farmers

REENFORCEMENT FOR BEE COMBS AND COMB FOUNDATIONS—Which will prevent sagging and consequent distortion and breaking of the comb, on account of atmospheric changes, weight, or the stresses during handling or transportation. Patent 1674501. H. C. Dadant, c/o Dadant & Sons, Hamilton, Ill.

STALK CUTTER—Adapted to be drawn over a field to cut the stalks at predetermined small lengths, and means whereby to tilt the knives in a forward and downward inclination to effect the severing of certain stalks. The inventor has been granted two patents 1676105 and 1676106. J. F. A. and R. A. Michalka, c/o Michalka Bros., Cameron, Texas.

CULTIVATOR, WEEDER AND DIGGER—Including a wheel rotatably mounted on a frame and having a plurality of earth-working elements in the form of curved prongs. Patent 1677803. A. R. Tenger, Box 245, Marshfield, Oregon.

IGNITION DEVICE FOR SMUDGE POTS—Adapted for use in citrus groves, is normally inactive but upon a predetermined low degree of temperature becomes active to ignite the smudge for raising the temperature. Patent 1676368. J. A. Ulmer, 2501 East 52nd St., Huntington Park, Calif.

FLY NET FOR HORSES—A net-work of hemp or cotton thread to be applied to four-footed animals to frighten and prevent flies and other insects from troubling the animals. Patent 1677839. A. Montels, Aristobula del Valli 1782, Buenos Aires, Argentina.

COTTON-BOLL BREAKER AND CLEANER—Whereby the bolls are broken open and the cotton liberated from the burr, and subjected to the cleaning action of the beaters. Patent 1678210. F. B. Cumpston, Blooming Grove, Texas.

from the Patent Office. It is significant that the majority of these inventions are not for labor-saving methods, but are for new products to manufacture which will keep labor busy.

In regard to manufacturers: They are consulting all available sources for new articles of manufacture, things which will require the employment of additional labor. For example, here are two samples of such letters as this department has been receiving:

"When you have clients with inventions which have to be made principally of sheet metal, and who are looking about for a good manufacturing connection on a royalty basis, we would like to have you put them in touch with us. You can readily find out from Dun and Bradstreet, or any bank, that we are a large and reputable firm, financially responsible, and with a background of experience dating back to 1880. We are really in a position to deal to advantage with any clients whom you may see fit to refer to us."

"We would appreciate very much your placing our name on your list of manufacturers who desire receiving patents requiring screw machines, blankings, plating, et cetera."

Obviously, industry is just as anxious to find things to make and sell as inventors are to provide them, and it is especially fortunate that at this time there is plenty of money to finance new or extended undertakings. The forces to correct the existing period of unemployment are at work and it should be no great time before the industrial situation is back to normal.

Cross-Licensing by Uncle Sam

IN a memorandum to the heads of all government departments and establishments, Brigadier General H. C. Smither, the Chief Co-ordinator, announces a new policy having to do with licensing patents which the government owns or controls and cross-licensing of such patents with those owned by private corporations. He will have final power in disposing of all proposals for such licensing. The memorandum reads as follows:

"All proposals for the licensing and cross-licensing of patents owned or controlled by the government will be forwarded to the Chief Co-ordinator for reference to the Inter-departmental Patents Board, before which will appear such administrative and technical representatives as the department heads concerned may desire to designate. The findings and recommendations of the board will be submitted to the Chief Co-ordinator for his action and will have no force until approved by him. All subsequent allocations or modifications of licenses or cross-licenses will be handled in the same manner. Proposed revocations of any license will be reported to the Chief Co-ordinator."

It had been apparent that necessity existed for a co-ordinated policy with regard to such licensings and cross-licensings. To determine a policy which would safeguard the government and at the same time assure the co-operation of industry, a conference of representatives of executive departments was held. The memorandum setting forth the new procedure resulted from that conference.

BROODER—Having means for maintaining a correct temperature which increases gradually and regularly from the outer edge of the hover to a central source of heat. Patent 1679271. W. C. Sanctuary and W. A. Jones, 11 Cottage St., Amherst, Mass.

Of General Interest

DISPLAY BOX—By means of which an article may be held against movement when the box is closed, and in display position when the box is opened. Patent 1673658. J. Andersen, 8715 178 St., Jamaica, L. I., N. Y.

CAN OR SIMILAR ARTICLE—Including a closure for the body and a lever fulcrumed on the closure adapted to bear against the body to facilitate removal of the closure. Patent 1673693. W. C. McLelland, 113 Milan St., Houston, Texas.

PIPE COUPLING—For connecting two flexible pipes, or a rigid and flexible pipe, yet maintaining a fluid-tight joint and allowing rapid connection and disconnection. Patent 1673338. T. E. Mitchell, 325 Citizens Bank Bldg., Los Angeles, Calif.

LOOSE-LEAF BINDER—An adjustable back cover which is held in position on the inside sections by elements which also carry the binding straps and locking mechanism. Patent 1673315. F. H. Crump, 225 E. 4th St., Los Angeles, Calif.

PENCIL-SHARPENING DEVICE—In which the point is formed by the shaving action of a cutting blade, the device is adapted to use, although not necessarily, old safety razor blades. Patent 1672429. G. H. Schmidt, P.O. Box 31, Alhambra, Calif.

EDUCATIONAL DEVICE—Which will display to pupils various groups or columns of figures for addition, and in which many combinations of figures may be had. Patent 1674553. C. S. Jones, Clarkson, Neb.

CLOTHESLINE HOLDER—Having an automatic clamping member in the housing forming a part of the clamp, and so constructed that a reliable guide is formed for the rope. Patent 1674559. G. J. A. Molique, 2712 Denver St., Granite City, Ill.

INSIDE SAFETY DOOR FASTENER—Which may be conveniently carried about by travelers who wish an additional door fastener, and readily attached or detached from the stile of the door frame. Patent 1671454. E. H. Stoutenburgh, c/o M. Averill, 1615 Broadway, Oakland, Calif.

MEANS FOR SECURING BARREL HEADS—Comprising a ring forming channel members, a bevelled ring arranged on and surrounding the barrel end, and a head which prevents the ring moving. Patent 1674578. A. H. Trageser and L. Hassinger, 447 W. 26th St., New York, N. Y.

CAN TOP—Having an easily releasable means for locking a pouring spout on the can top, making the can practically air tight, and preserving the contents. Patent 1674590. M. D. Cohen, 1001 Ind. Life Bldg., Nashville, Tenn.

MERCHANDISE PACKAGE—Wherein a large number of fragile inner containers can be stored and held out of contact for transit, within a greatly restricted area. Patent 1673956. A. B. Stewart, 315 W. 9th St., Los Angeles, Calif.

FAVOR DISTRIBUTOR—In the form of a light support, which has a receptacle made of sections adapted to be folded to conceal the favor, or render it accessible. Patent 1676137. W. E. Dodge, 315 W. Highland Ave., Shawnee, Okla.

BUILDING MATERIAL—Adapted for use either as a wall board, or as a metal lath, so constructed that plaster will be keyed to the material without danger of cracking. Patent 1677073. G. Cohen, 201 West 49th St., New York, N. Y.

BREAD PROOFER—An arrangement of drawers in such manner that they constitute a cabinet when closed, for resting the dough prior to molding into loaves. Patent 1677043. J. M. Morrill, c/o E. S. Farley, Atty., Milbank, S. D.

RAZOR-BLADE SHARPENER—Having a holder from which the ordinary "Gillette" or "Durham" type of blades, may be readily removed and replaced, in association with the conventional type of strop. Patent 1676209. W. W. Upington, 2702 No. Junette St., Tacoma, Wash.

PORTABLE SOAP HOLDER—By which a cake of soap can be securely held, and manipulated, as in washing, without bringing the hands in actual contact with the soap. Patent 1675022. V. F. Creegan, c/o Postal Telegraph Co., Albuquerque, N. M.

DOLL OR THE LIKE—Having a coupling means which enables the torso, arms, and legs to be pressed into coupling engagement, yet permitting free movement of the arms and legs. Patent 1676096. A. Kwasnicki, 1350 Willoughby Ave., Brooklyn, N. Y.

SORTING DESK—Including a receptacle for large stacks of mail or newspapers, and means for securely holding each shelf and allowing for the adjustment of various sized pigeonholes. Patent 1675454. S. A. Harrison, 1379 W. 22nd St., Los Angeles, Calif.

PAPER RECEPTACLE—For example, a milk bottle constructed from a single blank of folded material, the contents introduced thereinto through the bottom, sealed, and subsequently removed through the top. Patent 1677040. C. H. McGiehan, c/o Mrs. C. H. McGiehan, Nyack, N. Y.

ANTIMARRING MEANS FOR PICTURE FRAMES—Having means associated with the usual cord or wire holding screw eyes, for preventing marring of the wall, should the picture frame move. Patent 1675771. S. Sterling, Biltmore Hotel, Los Angeles, Calif.

HOSE PROTECTOR—In which a plurality of sections formed of metal are pivotally connected together, and conform to the configurations of the hose when in use. Patent 1677077. D. D. Fortune, c/o G. W. Fernstrom, 718 18th St. N. W., Apt. 52, Washington, D. C.

PROTECTIVE APPARATUS—For the protection of banks, treasures, or stores, when a hold-up is attempted, whereby mechanism is actuated at a distance from the door, closing the same. Patent 1675428. E. J. Schiffko, 689 24th St., Oakland, Calif.

SAFETY-DEPOSIT RECEPTACLE—By means of which, when traveling in a public conveyance such as a boat or train, one is able to protect ones valuables against theft. Patent 1676707. E. S. Peer, P.O. Box 77, Central Station, Portland, Oregon.

TWINE HOLDER—Wherein the shaft is arranged to facilitate the application or removal of the cord, and a detachable cutter blade is provided on the support. Patent 1677799. R. Salvaggio, 1330 Magazine St., New Orleans, La.

COTTON-TIE SPLICER—For cotton bales, which will present no sharp edges and will have a maximum of strength, designed to conform to the requirements of the law. Patent 1677828. P. L. Howlett, Brawnwood, Texas.

ATTACHMENT FOR WRITING IMPLEMENTS—Which includes finger receiving devices which insure the proper gripping of the implement, and facilitate the teaching of penmanship. Patent 1678578. J. M. Utrilla, Santa Domingo 7, Guanabacoa, Habana, Cuba.

SELF-TEACHING DEVICE—In the nature of a holder in which a number of members bearing interrogatory indicia may be removably associated with members bearing answers, written by a child. Patent 1678621. W. H. Holmes, 60 South 3rd Ave., Mt. Vernon, N. Y.

FOOD TRAY—By means of which various foods constituting a meal, and the necessary forks, spoons, etc., can be transported without fear of the foods intermixing. Patent 1677276. L. A. Deicken, 1156 Gordon St., Los Angeles, Calif.

SEAT BACK—Constructed with an adjustable clamping means for giving particular angles, may be attached to a boat seat, or board seat in a field stand. Patent 1679238. H. A. Boies, c/o A. R. Sturtevant, Middlebury, Vt.

FIRE EXTINGUISHER—For oil storage tanks, adapted to serve as a temporary cap, for a burning tank, and to discharge steam for effectively smothering the fire. Patent 1679243. D. Fasul, 1739 Pilgrim Ave., Bronx, N. Y.

WINDOW CONSTRUCTION—Of substantially conventional appearance, but in which the sashes are mounted to swing inwardly to facilitate the cleaning of outside or inside surfaces without danger. Patent 1679278. J. Suter, 12 Park Ave., Guttenberg, N. J.

METHOD AND APPARATUS FOR PLACING POLES—Comprising a concrete base embedded in the ground, a supporting socket for holding the bottom of the pole with an air space slightly above the base support. Patent 1679297. A. Ehrler, c/o E. Stahlnecker, 28-50 37th St., Astoria, L. I., N. Y.

ATTACHMENT FOR OPHTHALMIC MOUNTINGS—In the form of detachable supplemental lenses for defusing glaring rays of light, so that the vision will not be effected. Patent 1679233. L. Strauss, 317 E. 34th St., New York, N. Y.

SEPARABLE FASTENER—By which two elements can be connected with facility and dispatch against accidental disconnection, adapted for such fastenings as curtain brackets, garments, vehicle curtains, etc. Patent 1678166. T. Repay, 1619 1/2 W. 22nd St., Los Angeles, Calif.

MILK-COOLING DEVICE—Whereby a number of fine streams of cold water are directed to the neck of the can, and a water film permitted to flow down over the surface. Patent 1679302. H. J. Foster, Stowe, Vt.

POLE—Stamped from a single piece of sheet metal, will resist the strain of a fence or telegraph lines, may be used as a base for old or rotted poles. Patent 1680172. C. E. Pine, 10 So. Chevern St., Oklahoma City, Okla.

BUILDING CONSTRUCTION—A concrete flooring which is light construction yet has great relative strength, and in which the ceiling is level, with no projecting beams. Patent 1679672. S. Klein, 64 East Lake St., Chicago, Ill.

POWDER BOX—Including a container having an inner tray with sifter openings and a puff of sufficient size to fill the tray and prevent spilling of the powder. Patent 1680150. C. S. Humphrey, c/o The Manhattan Can Co., 882 3rd Ave., Brooklyn, N. Y.

RECORD FILE—Comprising a series of pockets for receiving records or account sheets, each overlapping the other stepwise, so that the sheets themselves constitute an index. Patent 1680177. A. Schwarz, c/o G. Papponheim, Schulerstrasse, Vienna, Austria.

TOILET CASE—For holding the necessary articles for toilet in an accessible manner, may be used as a wall fixture or carried as a traveling accessory. Patent 1680196. E. C. Austin, Warronsburg, N. Y.

RADIO LOG AND PROGRAM DEVICE—Comprising a case in which a record of stations, wave lengths, etc., may be conveniently kept on one strip, and the daily broadcasting program on another. Patent 1680164. T. W. Montrose, 186 Bower St., Jersey City, N. J.

HOSE COUPLER—Particularly adapted for garden hose, readily applicable to the meeting ends of sections for hermetically sealing the same, may be quickly detached when necessary. Patent 1679709. C. G. Cooper, 740 First Ave., Yuma, Arizona.

Hardware and Tools

HINGE—Constructed from a minimum number of parts, and capable of supporting a maximum of weight with a minimum defacement of the door. Patent 1675262. E. Flagg, 111 East 40th St., New York, N. Y.

PIPE TONGS—For use in screwing and unscrewing pipe sections, couplings and tool joints of rotary drill pipes, applicable to pipes of widely varying diameters. Patent 1675748. F. S. Bunker, c/o J. W. Hughes, R. 1., Box 280, Long Beach, Calif.

LOCKING COUPLING—Adapted for rapidly attaching the end of a pipe to a fitting without the necessity for threading either the pipe end or the fitting. Patent 1676585. T. B. Tiefenbacher, 830 Sheridan Ave., No. Elizabeth, N. J.

UNDERREAMER—Which will rapidly enlarge the hole below the well, with a minimum amount of wear on the tool, and little danger of losing the cutters. Patent 1677812. C. H. Brown, c/o Brown Tool Co., Breckenridge, Texas.

SAFETY SNAP HOOK—Which may be easily applied to, or disconnected from a hoisting tub, and will withstand the hard usage of mine operations. Patent 1677814. O. R. and R. N. Close, c/o Roy N. Close, Cartersville, Mo.

YIELDABLE SUPPORT—A metal column, adapted to take the place of supporting timbers, which is yieldable under excessive pressure with out distorting the main body. Patent 1677796. R. D. Parks, 119 Jasper St., Houghton Mich.

CUSHIONING HANDLE FOR PNEUMATIC TOOLS—Including a number of springs interposed between the barrel and the casing in such manner as to take up and absorb shocks and jars. Patent 1679201. S. Byers, 411 North 'M' St. Bedford, Ind.

PIPE CUTTER—Wherein the various cutters are caused to travel in the same plane, and one or more used and guided to move in the path intended. Patent 1679321. R. F. McKay, 193 Joralemon St., Brooklyn N. Y.

ROTARY DRILL BIT—For boring oil wells and the like, allowing a circulation of water during the drilling action and a separate passage for the rising water carrying the mud. Patent 1678201. J. P. Samuelson, Box 622, Banning, Calif.

Heating and Lighting

RADIATOR VALVE—For automatically permitting the exhaust of air from steam radiators, by means of an air vent thermostatically actuated by the steam entering the valve. Patent 1673648. A. S. Svenson, 99 Curie, Clifton, N. J.

BOILER DUST DOOR—A construction which facilitates the expeditious repair of the brick work immediately adjacent the door in case failure occurs, and renders the door more durable. Patent 1674492. R. Will, 42-35 South 162 St., Flushing, L. I., N. Y.

HEATER FOR HAIR-WAVING OUTFITS—Capable of fitting over coiled hair without any adjustment of the parts, may be quickly applied or removed, and will almost surround the hair being treated. Patent 1674591. G. Decker, Yale Bldg., 216 High Ave., Cleveland, Ohio.

BOILER CONSTRUCTION—With an outer wall structure to define a heat chamber in which the gases of combustion will circulate to create a greater heat. Patent 1675194. M. O'Donnell, c/o Mrs. E. O'Donnell, 3718 Ruddie St., Long Island City, N. Y.

DAMPER—Which normally gravitates to closed position, is applicable to vertical flues of different inclinations, and can be adjusted prior to application to a particular flue. Patent 1674202. W. Hallberg, 10580 Ayres Ave., Los Angeles, Calif.

AIR CIRCULATOR FOR STOVES—An attachment for the type known as "parlor stoves," will cause the stove to throw off a maximum amount of heat, from a minimum consumption of fuel. Patent 1679307. W. G. Hutchison, 1610 Mound St., Portsmouth, Ohio.

OIL BURNER—Wherein the burner plate can be quickly pre-heated before the oil is turned on, and carbon on the surface of the burner is reduced to a minimum. Patent 1680193. V. Aiello, 28 Battle Ave., White Plains, N. Y.

STEAM GENERATOR—Or water heater, adapted for burning oil or gas, permitting ready cleaning operations, especially the removal of soot from the heat passages. Patent 1680166. L. N. Moss and J. S. Weston, c/o Louis N. Moss, P.O. Box 965, Cedarhurst, N. Y.

Machines and Mechanical Devices

GRADER—For road or street grading, including a mold board, and a reversible double-edged blade-bit which can be used a relatively long time. Patent 1674110. T. H. Harden, Dawson, Ga.

MEANS FOR LUBRICATING RAPIDLY REVOLVING SPINDLES—In which the oil is thrown from a chamber, through one channel, to the spindle bearing, and returns through another channel. Patent 1674605. F. Mortensen, Maskin- och Broleyggnads Aktiebolaget, Helsingfors, Finland.

BOX-CUTTING MACHINE—Adapted for forming paper boxes, which will not only shear the card board transversely, but will slot the ends to form flaps. Patent 1675247. W. W. Brust, c/o Sun Lumber Co., Wiston, W. Va.

CAR DUMPING APPARATUS—Whereby the contents of a car may be dumped and the car returned to starting position, the entire mechanism being operated by a single person. Patent 1675197. W. F. Schadel, c/o Kanawha Mfg. Co., 1520 Dixie St., Charleston W. Va.

PISTON RE-SIZER—Easily operated to re-size a piston of the split skirt type and to assure accuracy of size within a considerable range of expansion. Patent 1675238. W. C. Walker, c/o Aby & Tucker, 1st Nat. Bank Bldg., Tulsa, Oklahoma.

MOLDING MACHINE—Which may be quickly set for forming dough into rolls, or loaves, of practically any shape or length required in commercial baking. Patent 1674229. F. A. Scruggs, 1536 Ewing St., Los Angeles, Calif.

DRILLING MACHINE—A safety slip ring arrangement especially designed for use with rotary drills for preventing objects falling into the well while drilling or removing the pipe. Patent 1676129. H. C. Brewster, c/o Oil City Iron Works, Shreveport, La.

PUMP—Particularly adapted for oil wells, operated by a flexible cable without requiring the use of extra tubing pump rods, additional casing, etc., quickly lowered or removed. Patent 1675390. C. Starysky, Marysville, Texas.

SPINNING AND TWISTING MACHINE—Which permits a speed change without any variations of the length of the chain gear, by having the chain transmitting members adjustably supported. Patent 1676093. J. J. Keyser, c/o G. Hirschfeld, Alexandrinenstrasse 134, Berlin S. W., Germany.

PACKING FOR OIL WELLS—Which may be readily placed in position, and by a simple operation expanded, and locked into place, the packing being readily removed without breakage. Patent 1676168. C. Starysky, Marysville, Texas.

PROPELLING AND STEERING MEANS FOR POWER SPEED BOATS—Which will offer a minimum of resistance, and includes a pair of laterally spaced rear rudder blades, and forward side deflector blades, coupled for movement in unison. Patent 1676158. W. J. Roe, 256 Liberty St., Newburgh, N. Y.

SURFACING MACHINE—For effecting burnt surface decoration upon lengths of material, such as wood, and for obtaining a wide range of variation with the same peripheral pattern. Patent 1676111. E. H. Reiber, West Webster, N. Y.

DISPENSING DEVICE—Adapted to dispense cigarettes or like articles, and ejecting the same from the device one at a time. Patent 1676109. E. Oldenbusch, 366 Butler St., Brooklyn, N. Y.

AIR-TRAPPING DEVICE FOR LUBRICATING CUPS—Which will function to limit the amount of oil during the filling, and insure sufficient air to render the oil, when heated, responsive for proper lubrication. Patent 1675036. W. B. Lynch, c/o Areadia Lubricator Co., 1355 West Ocean Ave., Long Beach, Calif.

ICE-CAN BRACKET AND DROP TUBE—Which will serve to firmly retain an ice can against the

bottom of a freezing tank, so that in freezing the block will be square topped. Patent 1676089. W. W. Johnson, 400 Linden Ave., Memphis, Tenn.

PHONOGRAPH—Having a turntable and tone arm mechanism of such construction that it may be applied to an ordinary machine to enable the playing of much longer records. Patent 1676101. C. K. Lyons and A. H. Dunn, 86 Grimm Place, Baldwin L. I., N. Y.

TESTING MACHINE—For testing pipe fittings for minute blow holes cracks, and flaws in the walls, which would render the fittings unsuitable for use under pressure. Patent 1675802. F. A. Hamilton, c/o Southern Calif. Gas Co., Los Angeles, Calif.

SAFETY DEVICE FOR ELEVATORS AND THE LIKE—Which will give warning of a stretch in the hoist cable, and in the event of a brake, will grip the guide rails, and stop the elevator. Patent 1676443. J. Kaspe, c/o H. Carminer, Bayreuther St. 26, Berlin W. 30, Germany.

FLUID PUMP—Which may be associated with an oil string casing to permit its withdrawal without disturbing the casing, and will prevent solid particles from entering the working area. Patent 1675434. C. Van Amburgh, 333 Dayman St., Long Beach, Calif.

LIQUID-VENDING APPARATUS—Adapted for dispensing gasoline, oil, or other liquid from a container, the liquid being releasable by the insertion of appropriate coin into a coin slot. Patent 1677113. N. W. Clayton, 1077 First Ave., Salt Lake City, Utah.

ALARM CLOCK—The mechanical construction of the working parts being made with such precision as to permit of ready replacement and repairs prolonging the period of usefulness. Patent 1677790. W. F. McKinley, 105 W. 2nd St., Little Rock, Ark.

WELL PUMP—In which a plurality of chain carried pistons are utilized to draw the water from the well upwardly through a suction tube to a discharge point. Patent 1677802. J. F. Struble, 225 East "B" St., Hutchinson, Kans.

APPARATUS FOR EXTINGUISHING FIRE—Whereby the exhaust gases of a combustion engine are employed for blowing a fire extinguishing powdery substance to the place of fire. Patent 1677875. C. Szilvay, c/o F. Schorn VII Erzsebet-Korut 19, Budapest, Hungary.

PRESSURE-CONTROL DEVICE FOR USE IN COUPLING OIL-WELL CASING—Whereby the joints between several sections of casing may be completed uniformly at the desired pressure, the device is constructed to endure rough usage. Patent 1677538. E. G. Whaley, 213 So. 9th St., Enid, Okla.

METHOD AND MEANS FOR PRODUCING EARTH-ENWARE PIPES AND PRODUCTS RESULTING THEREFROM—Whereby pipe and other clay products are made to possess structural integrity and homogeneous, and a strength to be expected of uniform texture throughout, with closeness of grain and homogeneity. Patent 1677808. F. J. T. S. and F. Alasio, c/o Uruguay Consul, 17 Battery Place, New York, N. Y.

MACHINE FOR DRILLING AND COUNTERSINKING BRAKE LININGS—By means of which a new lining may be formed, with countersunk rivet holes in alignment with the holes in the brake band, by one operation only. Patent 1678207. R. Brandt, 1625 Pacific Ave., San Francisco, Calif.

THREAD CLEANER—For silk threads, wherein means are provided for accurately spacing the parts for a proper sizing of the threads as they pass through the cleaner. Patent 1679258. E. C. Neu, c/o Schwarzenbach & Huber Co., 28rd St. and Bergenline Ave., Union City, N. J.

PROCESS AND MEANS FOR EXTRACTING PETROLEUM—By which the extraction of oil is greatly expedited by pressure transmitting conduits, and is not dissipated radially as from bore holes. Patent 1679638. J. L. Rich, Box 2, Ottawa, Kansas.

COTTON GIN—For removing fibers from cotton seeds by an air blower, the seeds being separately discharged free of cotton, without interfering with the removal of the lint. Patent 1680182. C. S. Cox, 1248, "R" St., Fresno, Calif.

Medical Devices

BODY BRACE—Which may be securely applied to the body, and adjusted on the wearer by shoulder and leg straps, constraining the wearer to assume an erect position. Patent 1678584. E. Branson, 319 North 3rd St., Livingston, Mont.

POCKET SPUTUM CUP—Constructed from a single sheet of material, with a closure flap formed to positively seal the cup against the escapement of the contents. Patent 1680151. J. Kauffman.

Musical Devices

UPRIGHT PIANO—In which is incorporated sound amplifying horns, under the ends of the keyboard, so that better quality and greater volume of tone, will be emitted. Patent 1679290. V. Bessier, 677 McDonough St., Brooklyn, N. Y.

BANJO STAND—A collapsible stand on which a banjo may be placed with safety during intermissions, may be accommodated in an ordinary banjo case. Patent 1673205. A. Romao, c/o Musical Accessories Corp., Oakland, Calif.

SOUNDING BOARD FOR PIANOS—For improving the tone, by attaching to the usual wooden ribs of the sound board, struts having flat faces, for increasing the resonant effect. Patent 1680180. W. H. M. Siegel, c/o F. Schwenterley Koniggratzerst 59, Berlin S. W. 11, Germany.

Plumbing and Fittings

URINAL—Which may be swung out from under a wash basin, and kept absolutely sanitary by film of running water covering the walls of the urinal while in use. Patent 1675263. E. Flagg, 111 E. 40th St., New York, N. Y.

PLUMBING FIXTURE—In the form of a mixing chamber for hot and cold water connections, for use with sink fixtures, capable of a wide range of adjustment. Patent 1679276. H. W. Slining, c/o Repeal Brass Mfg. Co., 2115 E. 27th St., Los Angeles, Calif.

Prime Movers and Their Accessories

INTERNAL COMBUSTION ENGINE—In which each cylinder has a single port and means for automatically connecting the single port of each cylinder successively with the intake and exhaust. Patent 1665421. G. H. Roose, 1228 N. Court St., Carroll, La.

SLEEVE OF THE ENGINE OF SLEEVE-VALVE TYPE—Which is protected from the alternate flexion and lateral reactions which are caused by the lateral control of the sleeve. Patent 1677051. C. Schaeffer, c/o C. Bletry, 2 Boulevard de Strasbourg, Paris, France.

VACUUM TANK—For actuating the suction and air valves through the medium of a float, constructed to permit of its direct association with a conventional form of carbureter. Patent 1676767. E. G. Burns, 2763 Fruitdale Ave., Los Angeles, Calif.

TRANSMISSION GEARING—In which the moving parts are enclosed in a substantially dust-proof accessible casing, adaptable for many uses where exposed gears would be subject to clogging. Patent 1679264. R. C. Parker, 415 John St., La Porte, Ind.

PISTON—Which may be constructed of light weight material, such as aluminum, or its equivalent, adapted for use with internal combustion motors. Patent 1678768. L. R. Davis, 278 Avila St., San Francisco, Calif.

Railways and Their Accessories

GRAIN-CAR-DOOR-OPENING MEANS—Which functions in conjunction with a pivotally mounted door, to apply a sufficient force to move the door against the heavy pressure exerted thereon. Patent 1674577. J. Towers, Fargo, No. Dak.

RAILWAY CROSSING—Which will positively prevent persons from unknowingly driving upon a track in a straight path, by being compelled to detour, stop, and turn at an angle. Patent 1674498. J. D. Bundy, De Kalb, Texas.

Pertaining to Recreation

GAME APPARATUS—Including a plurality of playing pieces simulating miniature locomotives and cars, the board surface containing tracks, and switch members adapted to predetermine the movement of the locomotives. Patent 1673705. M. E. Pesnel, 63 Tiffany Place, Brooklyn, N. Y.

SWING—Adapted to be actuated by bodily movements, cannot be accidentally overturned, and may be constructed almost entirely of lengths of pipe and pipe fittings. Patent 1674517. A. B. Newson, 1918 So. 3 East, Salt Lake City, Utah.

GAME BOARD—For the game of checkers, the surface being arranged with a greater number of squares, and an increase of playing pieces, with the possibilities of more intricacies. Patent 1674533. S. W. Templeton, 120 So. Butler Ave., Indianapolis, Ind.

TOY—Adapted to simulate various types of automotive vehicles, which may be easily steered and trundled along by a child without any great manual effort. Patent 1676085. L. E. Gerrish, 13 Whipple St., Kittery, Maine.

TOY CONSTRUCTION OUTFIT—Which comprises structural elements made of wood, in the form of rods, plates, blocks and disks, adapted to be assembled to produce a plurality of objects. Patent 1678602. G. G. Oldfield, 1104 Kamiake St., Pullman, Wash.

AMUSEMENT DEVICE—A playing table having a plurality of recesses into which a ball may be rolled, and in which when the ball is lodged the score is signaled. Patent 1678573. Y. Nakashima, Boardwalk 21st 22nd St., Coney Island, N. Y.

TOY PISTOL—Having means for insuring precision in feeding the cap strip and for preventing the product of explosion, when a cap is fired, from injuring the user. Patent 1678597. J. D. Kilgore, 127 14th Ave., Columbus, Ohio.

GAME APPARATUS—Comprising a board over which balls are manually projected toward a target, which when struck disappears from view allowing the ball to return for successive operations. Patent 1678189. L. S. McVey, Rulo, Neb.

SWIMMING GLOVE—Constructed with webs between the fingers which when spread cause the hand to act on larger bodies of water, resulting in greater speed. Patent 1679679. S. E. Neill, 2026 16th St., Bakersfield, Calif.

AMUSEMENT DEVICE—Including a plurality of targets, and a compartment corresponding to each target containing articles constituting prizes, which are automatically dispensed when the target is hit. Patent 1680167. I. Noda, Cor. Bowery & 15th St., Coney Island, N. Y.

Pertaining to Vehicles

SUPPLY MEANS FOR LUBRICANT-DISTRIBUTING SYSTEMS—By which the lubricant in the bottom of the crank case may be utilized for lubricating the whole vehicle with all its bearings. Patent 1671421. C. C. Goodrich, 639 Turk St., San Francisco, Calif.

RECOIL OR SNUBBING MECHANISM—Which can be easily applied to vehicles and will hold the body to a slow and easy upward movement, after a sudden downward pressure. Patent 1673230. C. M. Cronkhite, 1345 Graynold Ave., Glendale, Calif.

BUMPER—An inflated cushioning attachment, which will fit flat against the bumper to prevent injury, may be connected without skilled labor. Patent 1673692. C. F. Marston, 100 Chester Ave., Brooklyn, N. Y.

STOP-SIGNAL SWITCH FOR MOTOR VEHICLES—For use in indicating from the back of a vehicle, may be automatically manipulated, or used in combination with a direction indicator, and independently actuated. Patent 1673206. E. E. Safely, 410-42 St., Oakland, Calif.

DIRECTION INDICATOR—For indicating changes in direction of travel, either "left" or "right" turns, and "stop," in response to the operation of steering gear, or brake mechanism. Patent 1675215. J. F. Greene, 5920 162 St., Flushing Heights, L. I., N. Y.

TRACTOR TRAILER—Having coupling means by which the greater part of the trailer load will be supported by the tractor, and the tractor can turn at relatively sharp angles. Patent 1675267. P. E. Hanson, 1801 Strand, Galveston, Tex.

GASOLINE-DISPENSING SYSTEM—A device by which any one of a plurality of vending stands may be operated for dispensing gasoline independently of the other stands. Patent 1675231. H. F. Stoke, Roanoke, Va.

SIGNALING DEVICE FOR AUTOMOBILES—Adapted to display a "slow" signal when the clutch is in low gear, and a "stop" signal when the brake and clutch pedals are depressed. Patent 1675203. C. L. White, 3915 Labadio Ave., St. Louis, Mo.

PRESSURE-INDICATING DEVICE—For indicating to a driver, while the vehicle is in motion, the pressure within a tire, a lamp being actuated by under or over inflation. Patent 1675410. J. H. Gartner, 150 Sequoia Drive, San Anselmo, Calif.

LAND AND WATER VEHICLE—Which may be used as an automobile on land, or as a boat in the water, without making any alterations, or without the operator leaving his seat. Patent 1677846. G. E. Powell, 2347 Claybourn Ave., Chicago, Ill.

AUTOMOBILE HEATER—Wherein the heat radiating tubes are disposed in the bottom of the car and are fed through an adjacent valve from the exhaust pipe, without leakage. Patent 1678567. H. L. Hubbard, 13823 Fernwood St., E. Cleveland, Ohio.

DIRECTION SIGNAL—Capable of being associated with, and manually actuated by, the rotation of the conventional steering mechanism of a vehicle, to indicate "Left" or "Right" turns. Patent 1678197. D. W. Pratt, 1904 11th St., Santa Monica, Calif.

ANTI GLARE SHIELD AND METHOD OF MAKING THE SAME—Which in light of average intensity, or at night, allows objects to appear in their natural colors, but in strong light, or sunshine, becomes colored and diminishes glare. Patent 1678218. R. M. Gruss, 458 Fell St., San Francisco, Calif.

SPEED-WARNING DEVICE—Which may be attached to a radiator cap and normally hid from view, but is raised by air pressure to warn the driver of dangerous speed. Patent 1679320. J. Matthews, Box F, Abbecon, N. J.

AXLE GAUGE—Particularly adapted for use in gauging the alignment of axles on automobiles equipped with four-wheel brakes. Patent 1678761. R. P. Bernhard and V. D. Black, Jr., c/o Coast Mfg. & Supply Co., Box 227, Livermore, Calif.

DEVICE FOR PREVENTING RETROGRADE MOVEMENT—Which will automatically lock the running gear of an automobile to prevent backward movement when the car has been stopped on an inclined roadbed. Patent 1680148. J. L. Gonard, Cayteville, N. J.

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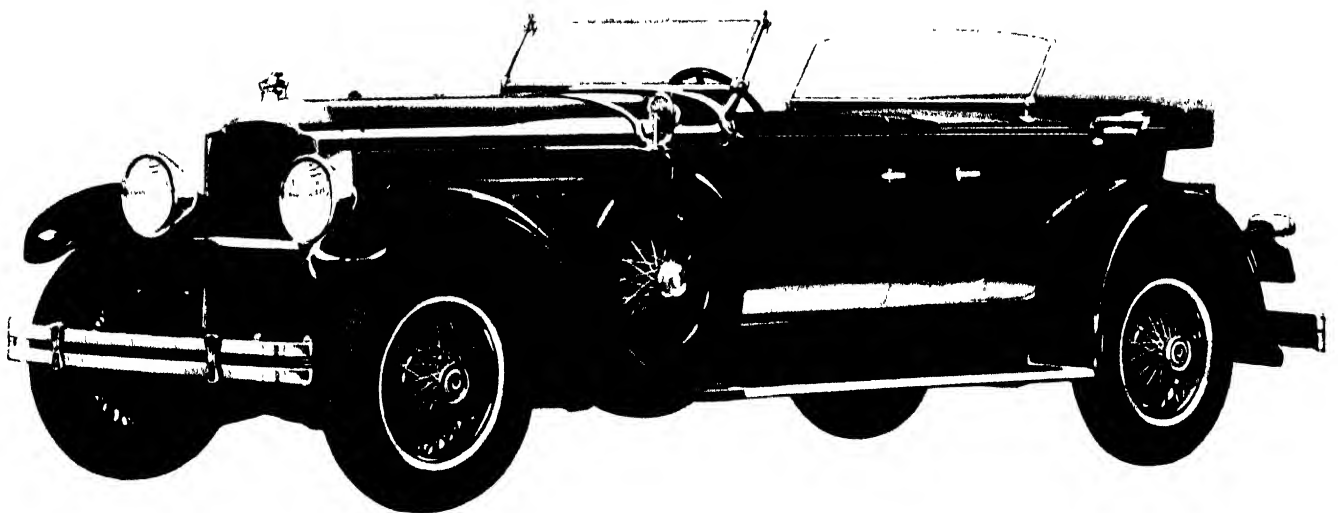
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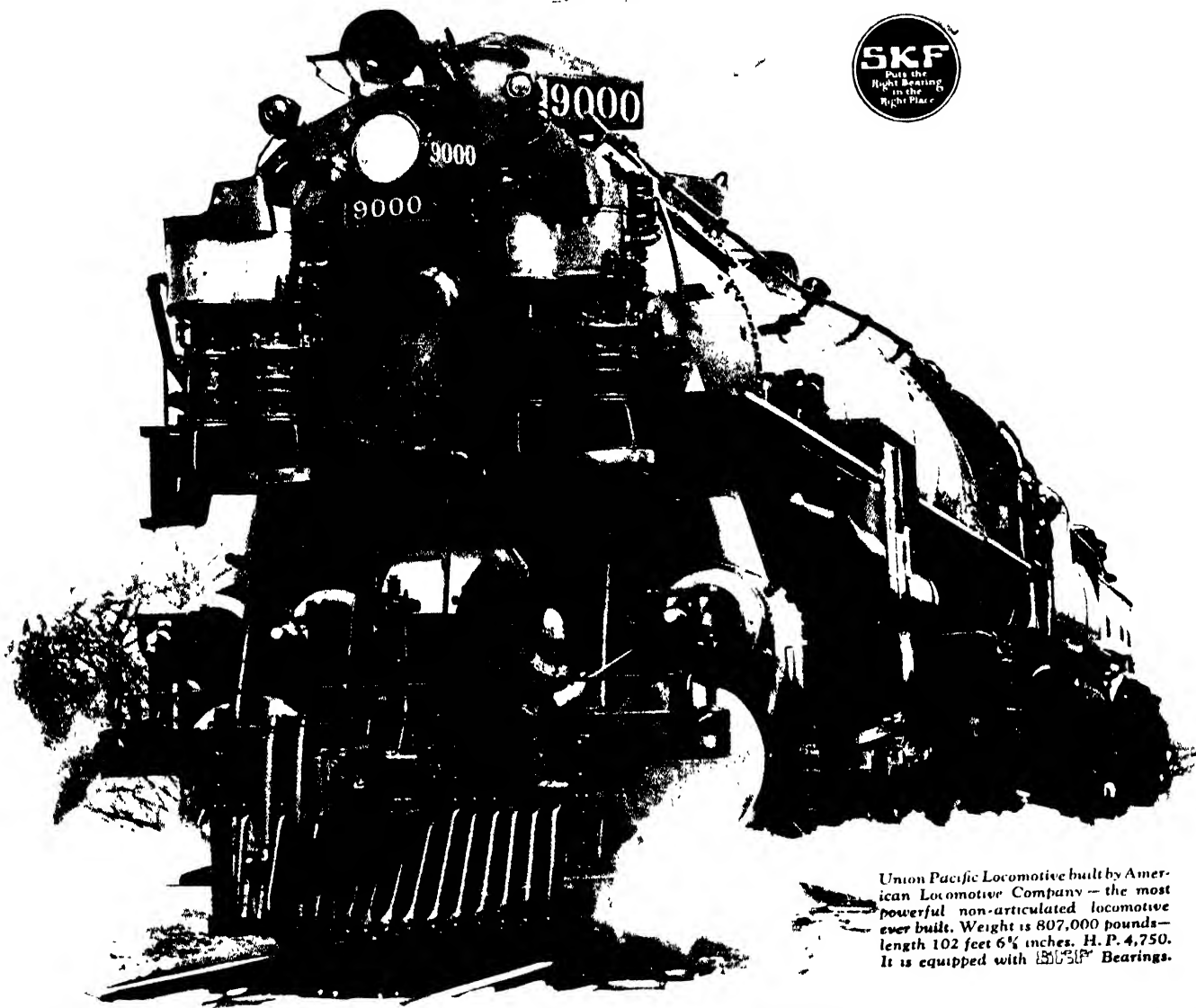


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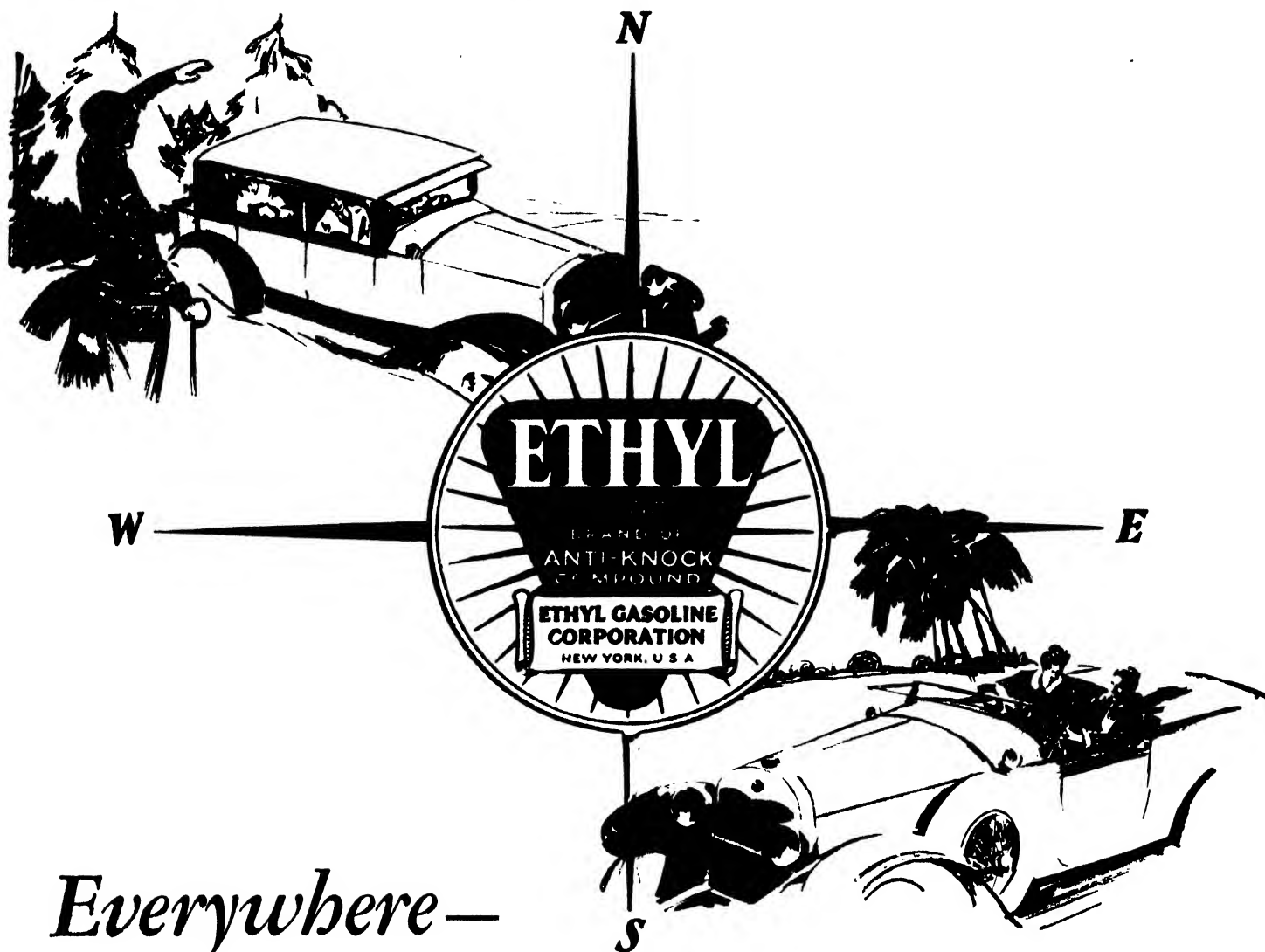
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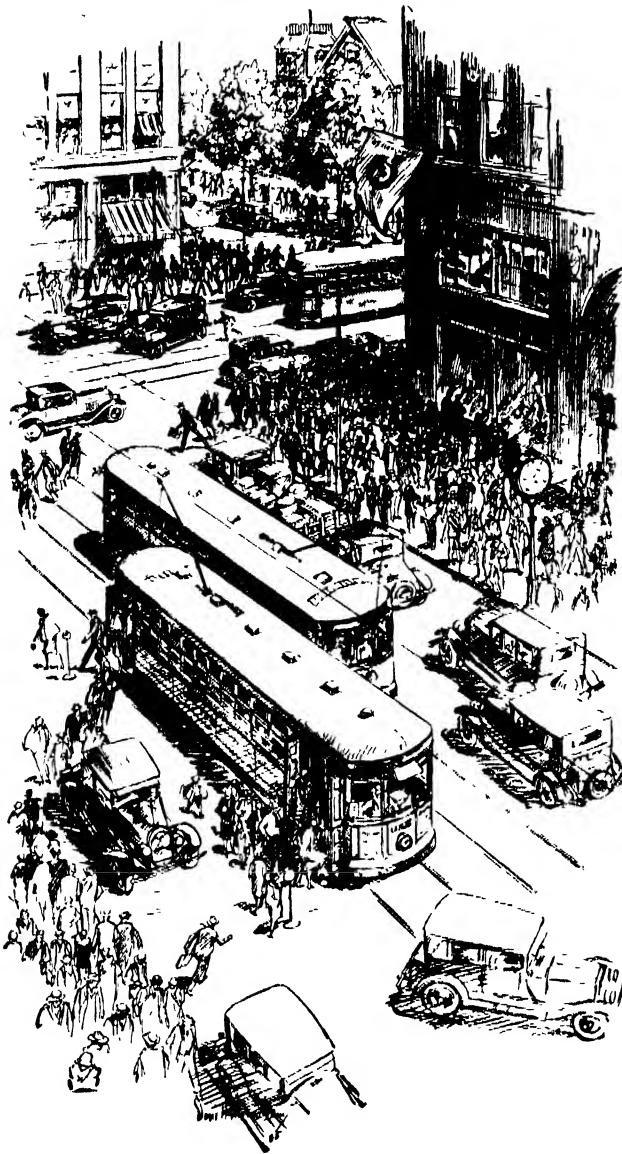
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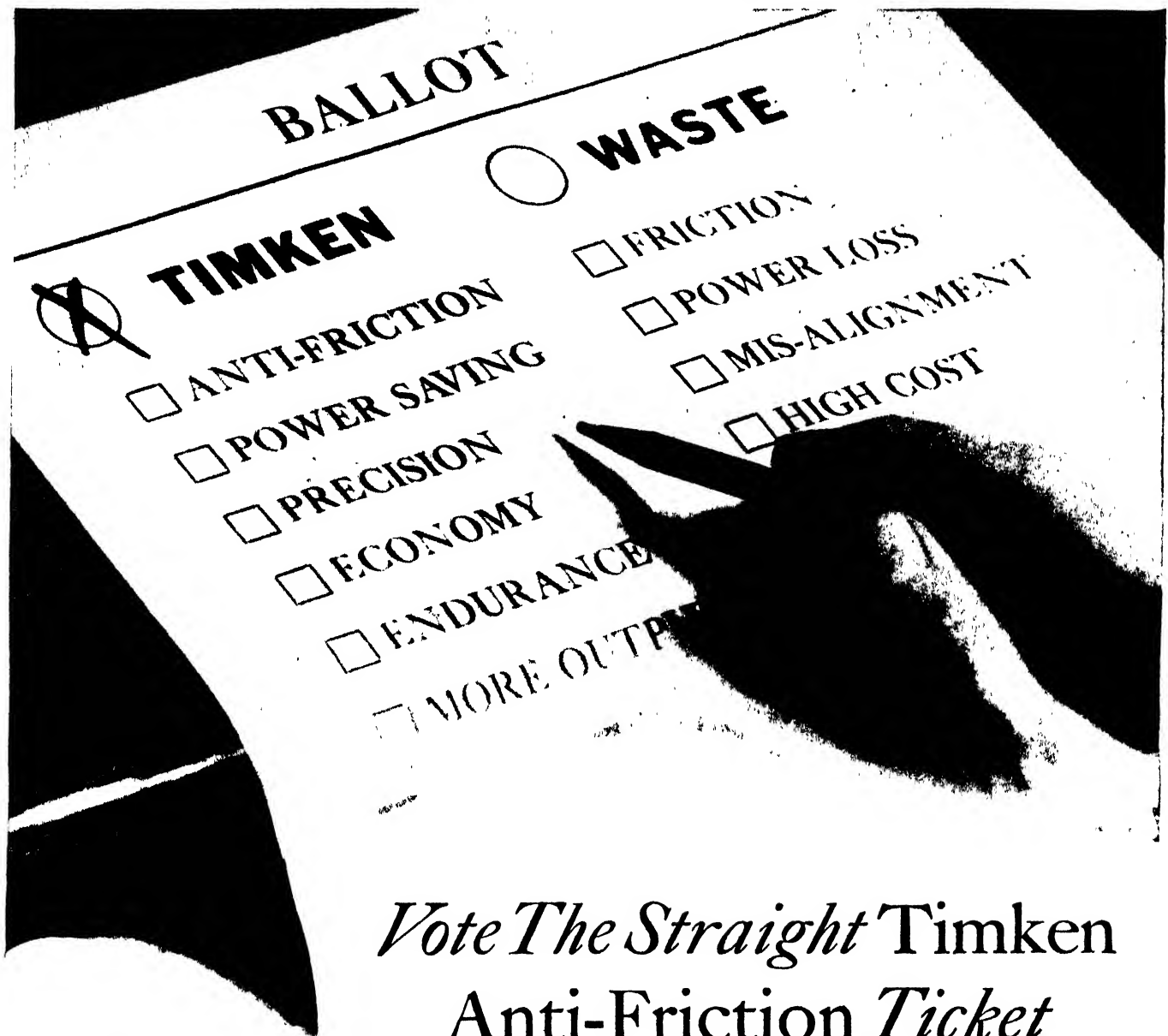
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COVER

On page 430 appears an intensely interesting article dealing with the fauna of the caves of the Ozark Mountains. One of the little creatures of this region that the author brought back with him is the salamander *Eurycea lucifuga*. This tiny creature—it is only between three and four inches long including its tail—has lost neither pigmentation or eyes, as have many other habitual cave dwellers. Read about these unusual animals in the article mentioned.



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in short, wherever wheels and shafts turn. Timken electric steel, Timken tapered construction and Timken *POSITIVELY ALIGNED ROLLS* act as a continual pledge of permanency.

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Looking Ahead With the Editor

What's Going On in Europe

AMERICA has no monopoly on scientific achievement. Knowing this, SCIENTIFIC AMERICAN keeps Europe, the greatest outside field, under constant observation. Accordingly, when the British Association for the Advancement of Science recently met in Scotland, one of the editors, Albert G. Ingalls, attended. Afterward, Mr. Ingalls toured the continent, going to centers of learning, industrial cities, et cetera, taking notes and contracting for future articles. As a result, some interesting material is in store for our readers.

Carnivorous Plants

THERE will be published soon an illuminating description of the bladderwort, in many respects the most remarkable of the animal-trapping plants. Totally devoid of roots, it drifts in sluggish waters and captures its prey by means of a bladder-like appendage. Small crustaceans, eel-worms, et cetera, on touching the hairs about the mouth of this bladder, find themselves entrapped as it suddenly distends and sucks in water. The tiny animal is then digested by the plant.

Noise

NOISES are biologically harmful because they are an inborn stimulus to cause the fear reaction, according to an article ready for publication. The squeak of a file causes a chill to run up one's back; a pistol report causes an involuntary jump; and so on. The article tells of research indicating that, although man seems fully able to accustom himself to modern noises, his efficiency is really greatly lowered by them.

Whence Came Petroleum?

PRACTICALLY irreconcilable are the theories as to the origin of petroleum: the organic and the inorganic. After many years of discussion and study, the question still remains unsettled. Is oil an original substance; is it of rock origin; or was it once living matter? An article on hand cites theories, tells the why and wherefore of various views that are entertained, and points to the conclusion, widely accepted by scientists today, that petroleum is of organic origin.

Wide Utilization of Spectrographic Analysis

Quartz spectrographs are being used by many concerns that find it necessary to identify unknown substances at a minimum expense. In the stock room of one, some chemically pure platinum became accidentally mixed with some that was slightly impure. The spectrogram taken by them, enabled them quickly and easily to separate the two. An article soon to be published describes the instrument and how it works.

Every Issue Fully Illustrated

Q "But are you sure?"
"Certainly. I saw it in the SCIENTIFIC AMERICAN. A four-dollar-a-year subscription gives me the facts I want to know—and they are authoritative."

Among Our Contributors

P. Cormac



When it comes to questions of engine balance, wheels, and the like, nothing, not even the most involved mathematical determination of some obscure factor, is too deep for Professor Cormac. To him, these subjects on which he has written erudite books—are so fascinating that, where another would theorize and let it go at that, Professor Cormac digs in and gets down near the absolute bottom of things.

G. Kingsley Noble

Dr. Noble is an authority on reptiles. He has discovered independently a method of preserving the soft tissues and organs of reptiles, et cetera, by a process of paraffin infiltration. Dr. Noble has accompanied several expeditions as zoologist and has visited Guadeloupe, Newfoundland, and Peru and has traveled extensively in the United States in connection with his museum work. He combines his scientific observations with the spice of thrilling adventure.

Donald A. Laird

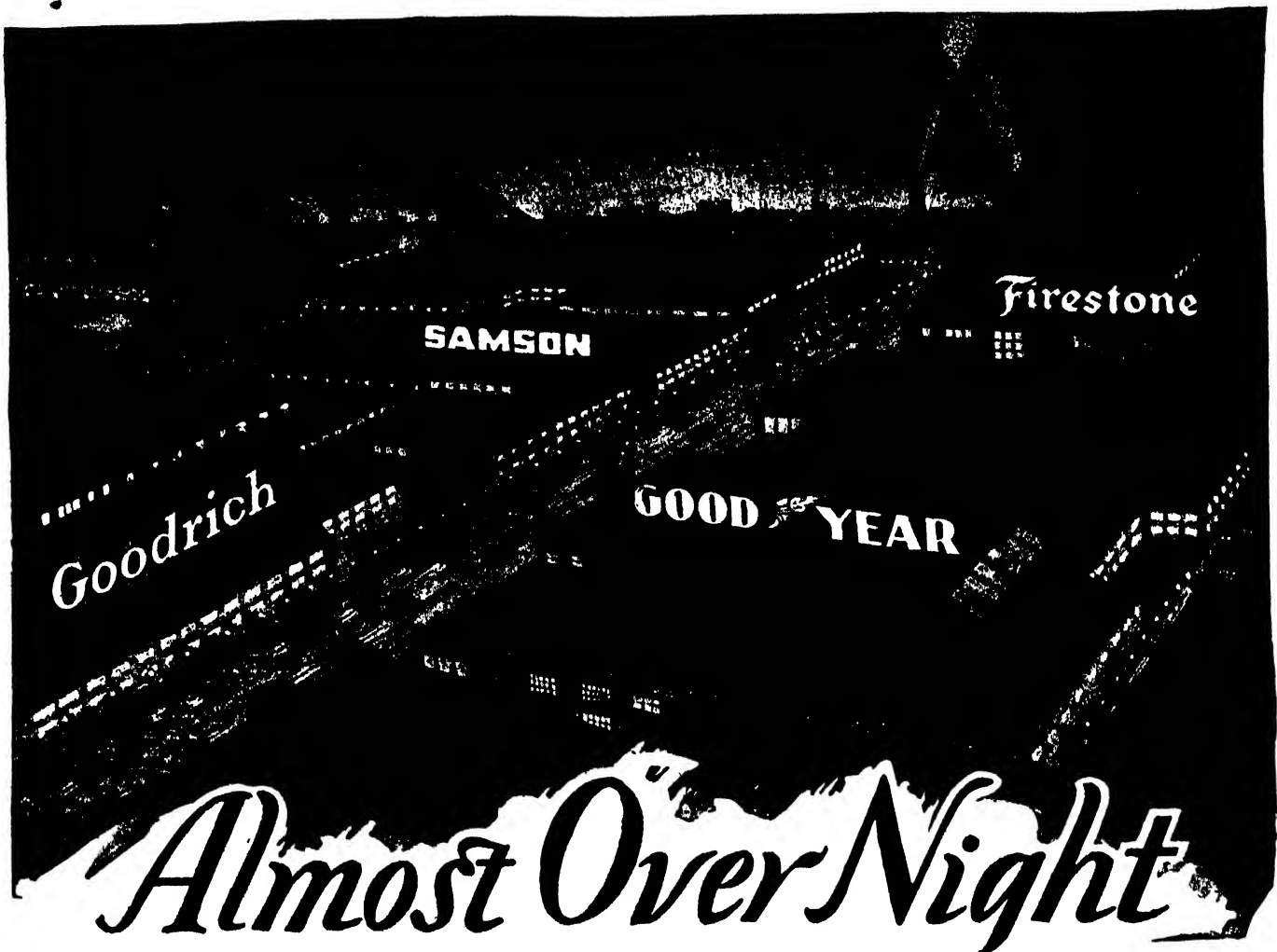
Industrial psychology has become a distinct profession. At Colgate University where much is made of psychology, Professor Laird heads the laboratory. He burrows into things most industrial workers take for granted and comes up bearing secrets worth many dollars to employers, industrialists, and people. Professor Laird is also editor of the magazine, *Industrial Psychology*, a welcome monthly arrival in our office.

Oliver B. Finn

Like many others who, in their spare moments, ride a hobby for edification and diversion, Mr. Finn, although a mining engineer, gets a great deal of enjoyment out of the study of plants. In this issue he has given us an interesting description of one of nature's most curious plants.

Paul R. Heyl

By this time Dr. Heyl of the Bureau of Standards, and our corresponding editor, is well known to our readers for his terse lucidity. His present article describes experiments tending to substantiate the concept of the Schrödinger wave atom, the theory of which he explained in July.



Almost Over Night

Los Angeles County Becomes America's Second Tire Industry Center

FOLLOWING the pioneer lead of Samson Tire & Rubber Corporation, Goodyear, Goodrich and Firestone have each established great tire plants in the metropolitan Los Angeles area—and still other major developments are now in progress.

As a result, Los Angeles County is today the second largest tire center in America, and present progress bids fair to make it first. Why did these great plants locate here? Because exhaustive investigation disclosed these advantages:

- lowest unit production cost in America.
- a higher standard of labor; ideal working conditions.
- lower plant maintenance expense and less plant depreciation.
- freedom from labor troubles.
- saving of expensive, long haul across country to supply Western markets.
- a tremendous tributary market quickly reached and more economically than from any other Western distributing point.
- big, concentrated market with exceptionally high per capita buying power.
- smaller plant investment necessary.
- excellent transportation facilities by rail and water.
- abundant cheap power and water.

These same advantages are bringing other great industries here. For specific information regarding manufacturing opportunities and distribution advantages in Los Angeles County, address Industrial Department, Los Angeles Chamber of Commerce.

INDUSTRIAL LOS ANGELES



Professor Vladimir Karapetoff

THE scientific engineer whose picture is shown above has been a professor of electrical engineering at Cornell University since 1904. He was born in Petrograd (now Leningrad), Russia, in 1876, studied engineering there and in Germany, and came to this country in 1902. He is one of a few known men to possess a natural "compartmental mind." As a result, he is equally at home in several quite distinct forms of activity, and is a prolific writer. He is the author of seven books and of some two hundred articles and other contributions to the press. Of late years he has been interested in problems of

atomic physics, mainly with the view to bringing some of the important recent discoveries and theories into engineering practice. The picture shows him in his laboratory at Cornell working on effects of electrical corona discharge upon insulating oils. In 1922 Professor Karapetoff received an International Montefiore Prize for electrical papers; in 1927 he was awarded the Elliott Cresson Gold Medal, "in consideration of the inventive ability, skill in design, and detailed theoretical knowledge of kinematics and electrical engineering, displayed in the development of computing devices."



Tungkal, a Village of East Sumatra

THE village, a part of which is shown in the above illustration, is situated at the beginning of the delta of the Tungkal River, on the coast of east Sumatra. All of the houses are built from 12 to 18 feet above the water level and are reached by only two flights of stairs. According to the author of the article on the Orang Lahut,

beginning on the opposite page, this village lies high and dry at low tide, but when the tide flows, the piles supporting the buildings are under water. The inhabitants of this and other Malay villages are rather well-to-do because of their traffic in sea food and products of the fields and forests. These are sold to Singapore.



AN ORANG LAHUT BOAT-HOME

These interesting and unusual people spend their entire lives in boats such as this one, carrying their entire household equipment with them. Toward the center of the boat is a crude fireplace, built of stones on bamboos, on which a small cooking pot may be seen

AFTER having passed several weeks in the virgin forests of the hinterland of Djambi in search of the Kubus, (See SCIENTIFIC AMERICAN, October, 1928) the next thing to do was to visit the Orang Lahut on the coast of east Sumatra, along the coasts of the Djambi and Indragiri districts.

With the exception of the short description in the encyclopedia of the Dutch Indies, I have not been able to find any mention of them, not even in the voluminous library of the Batavian Society for Arts and Sciences, and my searches after photographs of these people remained without result, even in Holland.

IT is, of course, no easy matter to develop photographs under such exceptionally difficult circumstances as are found in this tropical country, for the temperature of the water renders it difficult to get good results. Be this as it may, I am glad to be able to show at least something to make this highly interesting people better known. I must extend my sincere thanks here to the Dutch-Indian Government, especially to the art-loving General-Secretary, Mr. Erdbrink, who commissioned me to make these travels, and who gave me permission to publish these pictures.

The Resident of Djambi, Mr. Petri, loaned me the fine seaworthy government steamer *Robert*, and one fine day I set out in quest of a peculiar primitive people who pass their whole lives in small boats, cruising along the coasts.

The Orang Lahut

A Peculiar Malay People of Sumatra Who Pass Their Entire Existence in Boats

By DR. TASSILO ADAM

Late Ethnographer to the Dutch-Indian Government

At first we steered from the delta of the Batang Hari River, along the coast to the mouth of the Tungkal River, hoping to find the looked for water-dwellers there.

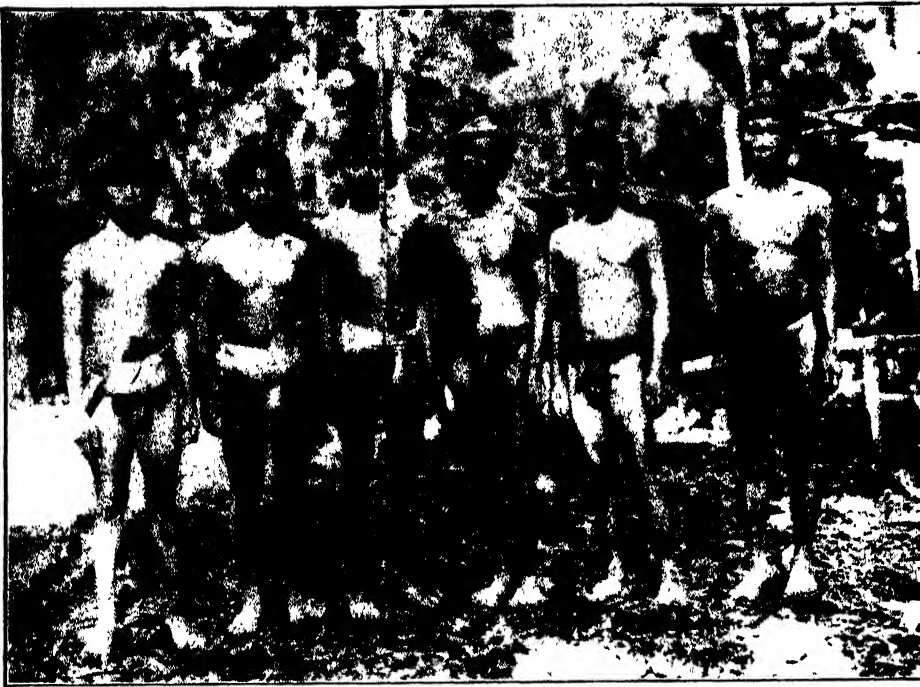
Where the delta of the last-named river begins, there lies the village of the same name (Tungkal), which makes quite a peculiar impression. Although it is in direct connection with Singapore by the steamers of the *Kgl. Paketvaart Mij.* and has in consequence also its own custom house, it retains its very characteristic original form. Certainly, like all these concealed lying villages along the east-coast of Sumatra, it has been a pirate settlement. All the dwellings and the few shops are built at a height of 4 to 6 meters above the water, also the "streets" there lie at the same height, on piles. At two places only did big stairs lead to the river, where the steamers, and other more or less large vessels, especially Malay *djunks*, lie.

The Malays living in this pile-built village are well-to-do through traffic in oysters, which are found there in

great quantities and are sold to Singapore; also fresh and dried saltfish, crabs, and shrimps, besides agricultural and forest products of the population in the hinterland, the lucrative commerce in rubber of more recent time not to be omitted. These are their good and regular sources of income. Although accustomed to deal with Europeans, they are reticent, spiteful to some degree, and certainly but little helpful.

WHEN it is low tide, these hidden villages lie quite dry. At high water the piles supporting the houses are under water, but at low tide a darkish grey mud, swarming with shrimps, sea-spiders, snakes and other creeping small animal life, is to be seen. The mouldy smell of the air is abominable, and there are legions of mosquitoes, so that one involuntarily asks one's self why people have settled in such unhealthy, inhospitable places of the world.

On the whole east coast of Sumatra, hundreds of kilometers of which form



AN ORANG LAHUT GROUP

Their only clothing consists of a tjawat or loin cloth drawn between the legs and fastened around the loins. The hair is kept cropped short with a crude trade knife seen thrust in the "belt"

sometimes only swamp and mud-districts, thousands and thousands of crocodiles live, and it is not to be wondered at that many people lose their lives every year by these abominable dwellers of the mud.

The population does nothing against these animals, and seeing with what carelessness these people bathe in the rivers, whilst everywhere such monsters are to be seen, sometimes swimming in the river, sometimes basking in the sun ashore, one can only regret the fatalism of the natives. Only if somebody has disappeared in the river, is a hunt made after the evil doer and the animal is *pantjenged*. That is to say, it is caught by a barbed hook, with a white hen as a bait, then dragged from the river by means of thick rattan lines, and killed by the male relatives of the lost one, who spear it with lances and then hack the body to pieces.

IN such highly dangerous localities as this do human beings live, but not even then in pile built villages where they can protect themselves against all the animals and mosquitoes. No, there are people who pass all their lives in small boats and are even born in them. These are the "Orang Lahut" (sea-people). An English explorer very happily named them "gypsies of the sea."

After I had cruised for some days along the coast of Tungkal, the *turagan* (Malay for captain) called me one day and made me look through the telescope. From a nook of the great swamp, grown over with Nipa-palms, there emerged two small boats. "These must be some of them," he observed, "for, with the exception of these

savages, nobody goes in a small boat about this region."

Quickly my motor-boat was alongside the steamer, and I was soon as near the small vessels as possible. Only my Malay servant and a Malay sailor who served as interpreter, were with me. The latter, the *turagan* told me, was a descendant of the Orang Lahut and was the only one who could converse with them. This youth had already attracted my attention by the dark color of his skin and by his vivacious eyes.

WE had hardly arrived near the boats—they made no attempt to depart—when we saw one man sitting at the end of each boat with a short paddle in his hand. The young sailor recognized at once his quondam tribesmen and whispered to me: "Master, these are the real ones." I told him to request them to come to Tungkal, which they also promised to do. "Will they really come?" I asked. "Master, whatever they promise they will also do. They will arrive this evening, surely."

"In each boat there is only one sitting. Are there no more of them in it, perhaps under the little awning of katjang-mats?" I inquired of my companion. "Oh, master," he replied, "there is certainly a whole family of them, but they did not like to be seen. They did not know yet who is in the motor-boat, and when they see you they are certainly too much afraid to come forth."

The two oarsmen with whom I had there come face to face, were already a good reward of these adventurous cruises. I was quite enthusiastic about this discovery! What people they were! The skin quite dark, a face

burnt and withered by sun and weather, a heavily developed upper-body, piercing, cunning looking eyes, short, frizzled unkempt hair—the first impression was the very opposite to my first encounter with the Kubus, the lowly inhabitants of the virgin-forests in the hinterland of Djambi.

We took our course back to Tungkal and waited for the two little boats. As they had not arrived late in the evening, I had little hope that their owners would keep their promise, and I laid myself down in bad humor on my truckle-bed on the deck of the *Robert*. Owing to the bad temper I was in, the terribly annoying mosquitoes upset me more than usually. The thick, close swamp air and the stench of the mud seemed so unbearable and unhealthy to me, that the fate of the people who lived there gave me much to think about.

WHEN I awoke next morning, still tired from the abominable air, all dismal thoughts were gone at once, for to my greatest joy I saw the two small boats lying alongside of my steamer. Like all primitive people, these water-dwellers were also astir at the first breath of dawn. I should have liked to climb down at once to witness their morning toilet, but . . . leisurely, only quiet, quiet . . . otherwise the game is up.

The boat is the dwelling in which



HIS TOES WORK

Note the distortion of the big toes due to using them to hold position in the boat

these peculiar people are born and pass their whole lives. Here is to be seen the whole domestic paraphernalia. Forward are three big baskets for storing oysters, crabs, shrimps and prawns. Then comes the fire-place. On split bamboos lie some stones on which the cooking pot stands. The fire is lit with matches which they get by barter. Behind stands the big tureen with rice, which is also acquired by bartering. Then, on a mat in front of the woman, stands the vessel (Malay) containing the ingredients for chewing betel.

THE dress of the men, if they do not happen to trade at a big place like Tungkal, consists always only of the *tjawat* cloth which is rolled together, drawn through between the legs and fastened round the loins. With these genuine Orang Lahut I did not find any ornaments; only one more civilized woman wore ear-appendages.

The bodies of these people are highly interesting. Through continuous living in boats and frequent paddling, the upper portion becomes very heavily developed. The musculature strikes one at once, but particularly the hands which attain quite incredible dimensions with some of them. The head has unkempt hair, hardened by the sea-air and cropped short with the knife, and sometimes with a tendency to frizzle. Of unwelcome tenants on these otherwise wholly uncultivated bodies there are many. With the women the hair, which is not very long, is worn *gondeh* in the Malay style—that is, drawn through a thin thong at the back of the head, to prevent it from hanging down. The children have their hair cropped short with the knife.



LADY OF THE BOAT

This is a close-up of the Orang Lahut woman who is in the boat shown on page 393

In contrast with the upper body, which as a result of the man's work is quite extraordinarily strongly developed, the lower part is sadly under-developed, through the life in the boats, the bent, sitting attitude and the small use of the legs. However, the native loves to make his big toe work, a facility which is particularly useful here in the boat for keeping to the crosspiece of wood, and its peculiar position and strong development is not to be wondered at. My attention had already been drawn by the *turagan* to the remarkable feet of these people, and when I saw this distortion also with an old man, he assured me that this phenomenon occurred frequently among this little tribe.

Disfigurements of the body there are. It is, however, very difficult to fix a certain rule in this respect. With the men circumcision is known, when they have become Mohammedans, which, however, does not always



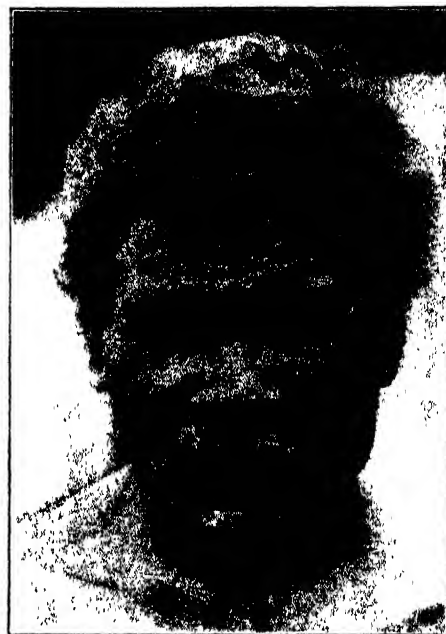
HUGE HANDS

Due to a lifetime spent in paddling, the Orang Lahut hands are incredibly large

seem to be the case. In any case Islamism is practiced only in a very superficial manner; of a religion as such they know absolutely nothing. With men as well as with women one sees filed-off teeth.

From all my researches it is to be concluded here, the same as with the Kubus, that we are dealing with an extremely primitive people, although the Orang Lahut in consequence of their intercourse with Malays and Chinese, rare and very superficial though it is, stand on a somewhat higher level.

These people have no settlements, at least not the genuine ones which I was looking for. There are, however, many of this people who live in pile-dwellings and do a regular traffic. These are registered, pay taxes, are Mohammedans and lead the same life as Mohammedans. The genuine Orang Lahut, however, lives only in a boat,



FRIZZLED HAIR

The salt air tends to harden the hair, which is unkempt and crudely cropped short

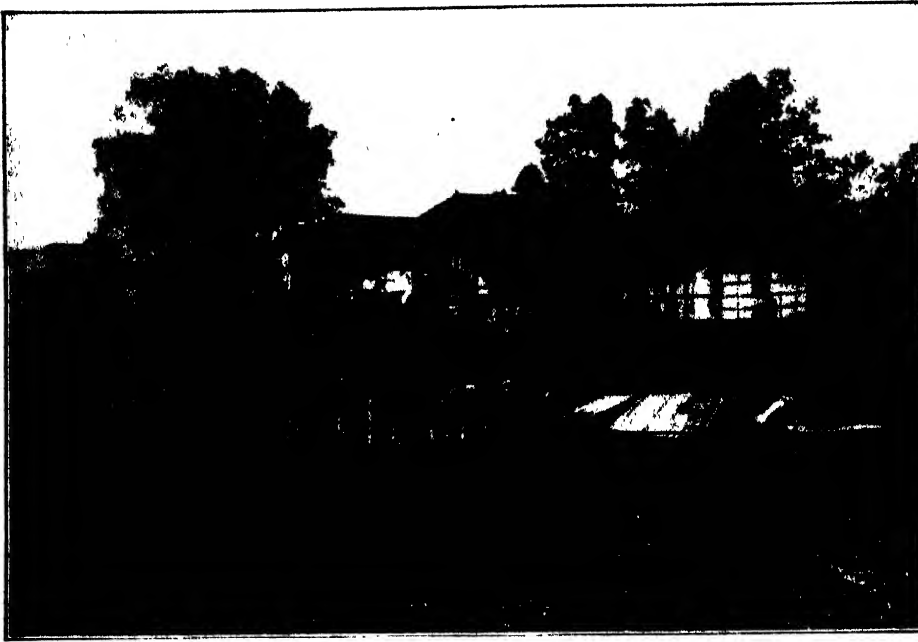
only comes to the villages with a good catch to barter, has no tribal chief and also has little intercourse with his tribesmen, although he is able to state rather accurately at which places those that live in boats are staying.

About customs at births I could learn nothing; it seems to take place just as simply and without any ceremony, as with the Kubus.

At marriages the Islamic laws are kept by those who call themselves Mohammedans. The young man who wishes to marry his elected one asks her parents for permission.

IN case these are agreeable, the youth has to pay down 12 Dutch dollars (equal to 30 guilders); that is, if he is able to. But he may also purchase on the installment plan and make time payments. But in this case he cannot get a divorce unless the full amount is paid to the wife. The *hakim* performs the marriage ceremony. If the husband wants a divorce, then he loses the 30 guilders paid, but if the wife wants to get divorced, then she must pay 120 guilders to the husband, which she will be able to do only in the rarest cases. If the man gets his divorce, then he may decide whether the children must go with him or whether they may remain with the mother; if the wife obtains a divorce and has paid the 120 guilders, then the children may choose for themselves. I think, however, that it is better not to give too much credence to these tales, and to take it rather that, the same as with the Kubus, not much ceremonial is required for a separation.

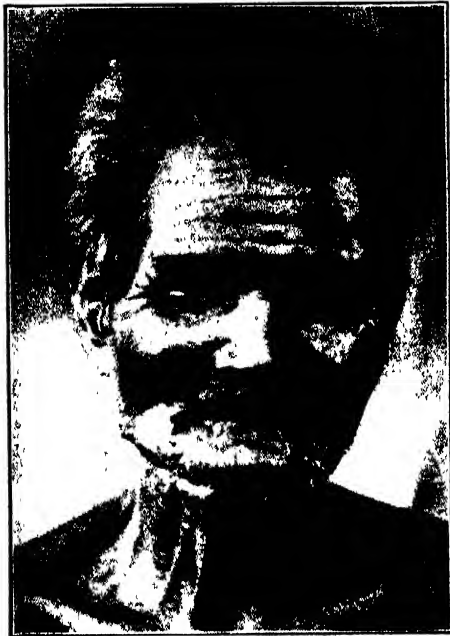
I could find nothing with respect to religious habits, nor anything about shamanism or other heathen customs. But that the people are highly super-



A MALAY VILLAGE

From this point, the author of the present article set out in his search for members of the Orang Lahut tribe. Some of the more civilized of these people live in these villages with the Malays

stitious, the following may prove: I wanted to take as many photographs as possible. The quite old man had absolutely no mind for it, and the women just as little. It wanted all my patience and persuasive skill, also many



A TYPICAL ORANG LAHUT

This is a close-up of the tribesman with the distorted big toes, shown on page 394

presents of rice, fruits and clothes, until at last the ice of resistance was broken. But when I wanted to begin, there came protests again, and quite a secluded spot to be searched for, where nobody could see that they were photographed by me. I went in advance with some of the steamer's crew who carried my apparatus, but . . . nobody followed after: they did not go by way of the high flight of stairs

from the river to the village. "No, Master, that they will never do; they are much too afraid for it," said my interpreter. "They will all climb up the smooth piles, 15 to 20 feet high, even the old man and the women." And so it happened, too! Covered all over with mud, they all drew themselves up the slippery piles. It was really comical to look at. To take the photos was a very difficult task, for apart from the contrariness of these people, rain set in, which spoiled much for me.

For the rest, see the photographs. These tribesmen seem to be as good-natured creatures as the Kubus. They are no sea pirates, but carry on trade in a very peaceful manner, but only with persons who are known to them.

If anybody dies and it happens to be in the neighborhood of one of the places where they always deliver their fish, then he is buried with Mohammedan rites. If, however, they are out at the open coast and anybody departs this life there, then he or she is only

covered up in the mud. I believe I may assume that this mode of burial occurs by far the most frequently.

To my great regret, I learned when it was too late to take a photograph, that these strange people have the following peculiar habit: during low tide they take a smooth board and glide on it like on a ski-runner with an incredible rapidity and agility, between palms and shrubs along the coast in order to catch small animals with their primitive tools, knives and short-handled nets. Thus they go right through the mud-lands peopled with innumerable crocodiles, without being afraid of the many dangers by which they are beset.

THERE are only few of the quite genuine "savage" Orang Lahut still living, according to statements given me—on the whole coast of Djambi and Indragiri 50 boats at the utmost, with four people in each on an average; thus perhaps 200 souls all told. The rest have their settlements, of which I visited some at Kwalla Retel and Solek. These, however, live like Malays and therefore they were not of such interest to me.

Just as their language is Malay, with foreign words and a foreign intonation, thus is their whole build and physiognomy Malay. It is, however, unfortunately an unsolved problem, whether they belong to the same group as the Kubus; whether they are of Malay descent, and have been abandoned by these; or whether they belong to one of the groups on the islands of Banka, Biliton or on the Riouw Archipelago.

When will these questions at last be thoroughly investigated? Is it not of scientific import to make researches as long as there is still a possibility for it? Soon the time will come when nothing will be left of this peculiar, remarkable little tribe, the same as with the Kubus. They are doomed, just as these, either to become extinct, or to be assimilated by the Malay and Chinese settled on these coasts.



ORANG LAHUT BOAT-HOMES OUT FOR A SAIL

World's Largest Electrically-Propelled Passenger Ships



"S. S. CALIFORNIA"

At the time of its launching, this was the largest electrically-driven passenger ship

LESS than a year after the launching of the *California*, first of three turbine-electric passenger vessels for the International Mercantile Marine Company constituting a total tonnage of electrically propelled ships greater than ever before constructed by a single company, the second ship, the *Virginia*, was recently launched at Newport News, Virginia. It is larger than the *California* but will be duplicated by the third, the three being the largest commercial steamships ever built under the American flag. Each of the twin screws on these ships is driven by an 8500 horsepower motor. Two marine-type, General Electric Company turbines, each rated at 8500 shaft horsepower, are directly connected to two alternating current gen-



All photographs courtesy General Electric Company

MAIN PROPULSION MOTOR

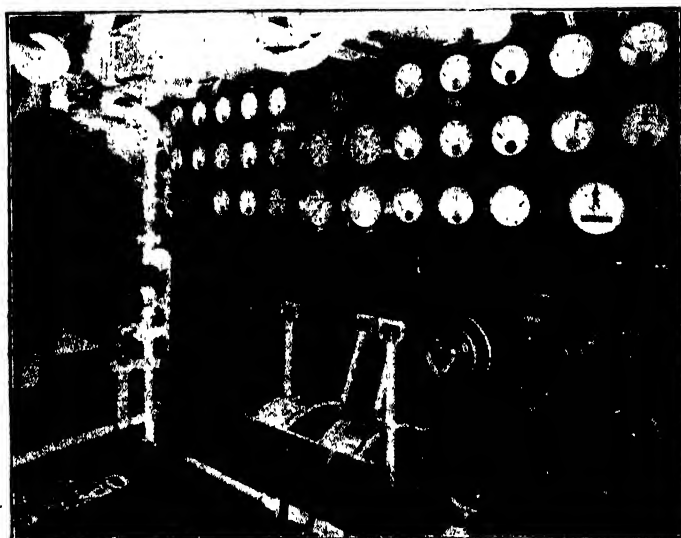
Striking view of one of the main motors for the Virginia posed in the factory where it was built

erators on each ship. These generators are rated at 5250 kilowatts at 3700 volts, their maximum continuous rating being 6600 kilowatts at 4000 volts. Control of the propulsion machinery is accomplished by a main operating control panel divided into two sections, one for main high-voltage control and the other for control of low-voltage field circuits. The ship's rudder is controlled by means of a hydro-electric steering gear designed to stand the pressure incident to putting the rudder from hard-over to hard-over in 30 seconds at a ship speed of 18 knots. The *Virginia* is 612 long, of 35,000 tons displacement.



PROPULSION TURBINE GENERATOR

Each marine type turbine is directly connected to a generator which supplies electric current to the 8500 horsepower propulsion motors



MAIN CONTROL SWITCHBOARD

Meters of all kinds, thermometers to show temperature of motor fields, revolution counters, and signal dial are all concentrated on this board

Our Point

Is He Dead?

INTO the North, across icy wastes and frozen seas, an airplane flew on a noble errand; weeks of silence followed; the world waited, hoped, searched; then came discovery of a part of the plane floating in the ocean: mute testimony of disaster; and, sorrowfully, it was conceded that Roald Amundsen and those who went with him were lost. This modern Viking, eccentric at times, both criticized and beloved, but always hailed as a man of iron courage and indomitable will, a veritable Spartan of a man, had come forth from retirement and had flown to the aid of the survivors of the *Italia* catastrophe.

When but a boy, Amundsen "irretrievably decided to be an Arctic explorer," to use his own words. He trained rigidly until his body was a marvel of physical perfection and hardened almost beyond belief. Thus in later years he was able to conquer, with slim resources, in the fishing smack *Gjoa*, the Northwest Passage that had defeated others who had the resources of governments behind them. He was first to reach the South Pole, first to attempt an airplane flight to the North Pole, and finally, a member of the first party to reach the North Pole in a dirigible.

It is barely possible that Amundsen and his companions survived whatever disaster befell their plane, in which event his resourcefulness, courage, and great endurance may even yet bring the group back to civilization. But, dying where he has lived and striven and suffered, his body could find no more appropriate resting place. And in death, his greatness of soul marks him as a character more worthy of emulation even than during his courageous life.

Aerial Signposts

IN these columns in the September issue, we made mention of the need of this country for more airports, and even at this writing, the reports from various parts of the country are encouraging. Particularly is this true of Southern California, where there are some 75 flying schools. In the entire state there are a total of 136 landing fields. Other parts of the country are also doing their bit to make flying more popular.

But there is one other phase that has not received the attention that it should. Flying fields are of no value

to an aviator who is not sure of just where he is. If he cannot find the field, it is obvious that as far as he is concerned, the field might just as well not be there. This brings us to the fact that there should be more sign-

Reclaiming the Desert

ONE of the most ambitious plans that man has ever considered is that for reclaiming part of the waste land of the Sahara Desert by means of, not irrigation in the general sense of the word, but actually changing the climate of the region.

In northern Africa, south and east of Biskra, are many large dry lake beds, connected by equally dry stream beds. All of this territory is below sea level, and the present plan is to construct a canal to the Mediterranean Sea. When this is finished, the waters of the sea will flow through the man-made channel and fill the below-sea-level basin. It is said that the result will be an inland sea with an area in the neighborhood of 30,000 square miles. Thus far will the work of man go in the achievement of the desired results. From here on nature will take up the burden. The dry winds sweeping up from the south, across this new inland sea, will pick up evaporated moisture, and carry it to the range of mountains to the north. Here the moisture will fall as rain, and the entire climatic conditions of the region will be changed.

It has been proved that the land of the section under consideration is inherently fertile, needing only water to render it fruitful. If this project is carried through to a successful conclusion, and its magnitude should not be an obstacle to present-day engineering, there is no doubt that northern Africa will bloom forth as one of the garden spots of the earth, and will become one of the important agricultural centers.

posts for the aviator. In the early days of motoring, lengthy trips were handicapped by the facts that there were few road signs and only poor maps. But these have been overcome to a great extent. Just such a process of evolution must be gone through in the case of flight. Every large town should have a prominent sign, visible from a great height, which should include an arrow showing the direction to the nearest airport or safe landing

field. (See further comment on page 467)

Nor is the sign alone enough. It should preferably be lighted at night so that it will be capable of 24 hour service. When every village, town and city has such signs and a safe airport, then will the general public feel that aviation has developed to an extent where everyday flying can be considered.

Conservation on the Footplate

THE railroad has been with us so long—it was only last year that the Baltimore and Ohio celebrated its centenary—that most people have come to look upon the locomotive as not only a handsome but a very perfect machine. But of late years, our engineers, while admitting its beauty, have questioned its perfection. They always knew that it was a voracious coal consumer, and under the keen spur of necessity, they set about the task of producing a locomotive that would give a maximum amount of power for a minimum expenditure of coal.

It is amazing to reflect that, not so many years ago, the average locomotive was burning up from six to eight pounds of coal per horsepower-hour; and this at a time when the best ocean liners were burning only one and one third pounds, and the big electric generating stations only one pound per horsepower.

Today, the latest locomotive, in spite of the fact that it is, in itself, a complete power station, whose weight it must carry and move at speeds of 60 to 70 miles per hour, compares most favorably in economy with the average factory steam plant.

Too great praise cannot be given to the locomotive designers who have wrought this great change in so few years. How was it done? Briefly stated: by using ample boiler capacity and large fireboxes; by an enormous increase in steam pressures, with the use of ample superheat; by using multiple cylinders (three and even four), and improved valve gears; and last (let us not forget this) by the intelligent co-operation of the men on the footplate.

And the result. We cull the following from an Interstate Commerce Commission report — an infallible authority. In the first four months of 1927, the consumption was 2,200,000 tons of coal less than for the same service in 1926. For the whole year

of View

the total saving was estimated at 17,000,000 dollars. Compared with 1920 this would represent a saving of about 92,000,000 dollars.

Do the railroads get the benefit of this? Ah, no. Increased taxes, declining rates and advancing wages are causing operating income to decline.

Radio Control

OCCASIONAL press reports relate the results of experiments in radio control of moving objects—automobiles, airplanes, and ships in particular. One of the latest deals with the maneuvering of a German battle-ship, controlled from another ship. Despite more or less deprecatory editorials in some of our foremost daily journals, these gradual developments may have a far-reaching significance. Their possibilities are not to be overlooked if we are to make full use of the advantages of radio.

True, in the present stage of the art, radio control of battle-craft from an enemy base can be combatted by a radio "barrage," and would also be dependent to some extent on weather conditions. But as research progresses, who can say what discoveries may be made with the ultra-short waves, wave changing devices, and other means of combatting these deterrents?

Furthermore, actual use of radio-controlled battle-craft is not the only object of experiments along this line. As Rear Admiral Fiske, U.S.N., Retired, pioneer inventor in the realm of radio control, states, the main reason for similar experiments performed by the United States Navy was for the purpose of obtaining data in regard to the action of gunfire on battleships while they are maneuvering—something that would be impossible if the ship had to be manned by human crews. With radio control, a target ship can be put through its paces while under fire, without danger to human life.

Neither the possibilities of radio control for actual battle use, nor for peace-time tests are to be overlooked. Radio may become a vital factor in the events of the world, aside from its use as a means of communication. Watch the developments.

Highway Safety

THE state of New Jersey has recently put in force a new set of highway laws superseding those which, in part at least, were relics of the horse

age. The new laws provide, among other things, for higher legal speeds in city and country, control of pedestrian traffic, standardization of traffic signals, regulation of trucking on the highways, and other points too numerous to detail here. The new laws have many friends and many enemies, but if properly enforced and observed,

No Cure

WE have heard a great deal recently of the efficacy of stunt-flying as a treatment for the deafness of an airplane passenger, and, knowing the hazard of such flights, have wondered how soon disaster would overtake one of these "treatment planes." Just the other day three persons were killed in a crash of a plane in a flight undertaken to cure deafness of a child.

As to the merits of this heroic treatment, it is difficult to arrive at any definite conclusion, but we do know that flying may prove exceedingly harmful. The noise of the engine, together with the rapidly changing atmospheric pressure on the delicate structures of the auditory apparatus, dulls the sense of hearing so that now many aviators are slightly deaf, according to Lieutenant-Colonel L. M. Hathaway, chief medical officer of the Army Air Corps. If aviators are affected in this way, is it not reasonable to believe that stunt-flying as a cure for deafness has slight merit despite the apparent cures in one or two cases? And, naturally, we don't wish to see a recurrence of the smash which killed the three who were "experimenting" with this method of treatment.

they should have the effect of materially speeding up traffic and relieving congestion. If they accomplish this, and at the same time add to the safety of all concerned, they are well worth while. And we think that they will do all of this.

Other states will do well to observe the results of the workings of the new laws, and rejuvenate their own out-of-date traffic rules to conform with present-day vehicles and demands.

The Passing Longhorns

WHEN Gregorio Villalobos, governor-general sent to rule New Spain, landed near Vera Cruz in 1521, he took from his ship some Spanish

calves. Their descendants, the famous longhorns, thrived in the New World, spreading over Texas and the Great Plains region of the Far West. From the Gulf to Canada they swept, pressing back the buffalo and the Indian.

The longhorns were long on legs, horns, and speed, but short on beef, and they, too, had to give way for gentler, meatier breeds, and their passing has been swift. Recently, when two forest agents, provided with a small appropriation to buy a few longhorns before the breed had wholly disappeared, began their search in Texas, they were told it was hopeless. The belief was general that not a single longhorn bull could be found in all the wide west.

After a long search down in the prickly pear country they found ten cows and a single bull. Then they combed the great range country between Houston and Beaumont and found two more bulls and ten cows. They shipped the lot off to the Wichita National Forest to build up a modest herd of 250 or 300 head.

And so the Texas longhorn at the eleventh hour is saved from total extinction. It is well. In song and story the creature will live as the Republic shall stand, for he is the very bone and sinew of the romantic Wild West that is no more. It is only right that we give future generations an opportunity of seeing him in the flesh.

Gliding

IN our October issue, the "Learning to Use Our Wings" department carried a resumé of the history of gliding. Since then old records for both altitude and distance have been shattered. Probably by the time these words reach our readers new records will supplant those that now stand. But it is interesting to note that Germany is leading in the matter of glider development. And gliders are the basis, the cornerstone, of aerial flight. As a sport, those who have tried it say that there is none more thrilling. And as an introduction to powered flight there is no better way of acquiring "air-mindedness." Let us by all means develop the art in this country. Gliders are cheap to construct, use no fuel, and if damaged are easily repaired. And the lessons learned while mastering flight in a glider are lessons that can be obtained in no other way.



From the Scrap-book of Science

◀ ROMAN CONCRETE WORK

This section of conduit, recently dug up in Germany, is interesting because it is made of concrete similar to modern concrete. It is part of a water supply line 43 miles long which Romans used



Herbert

▲ INSULTED BY FUMIGATION

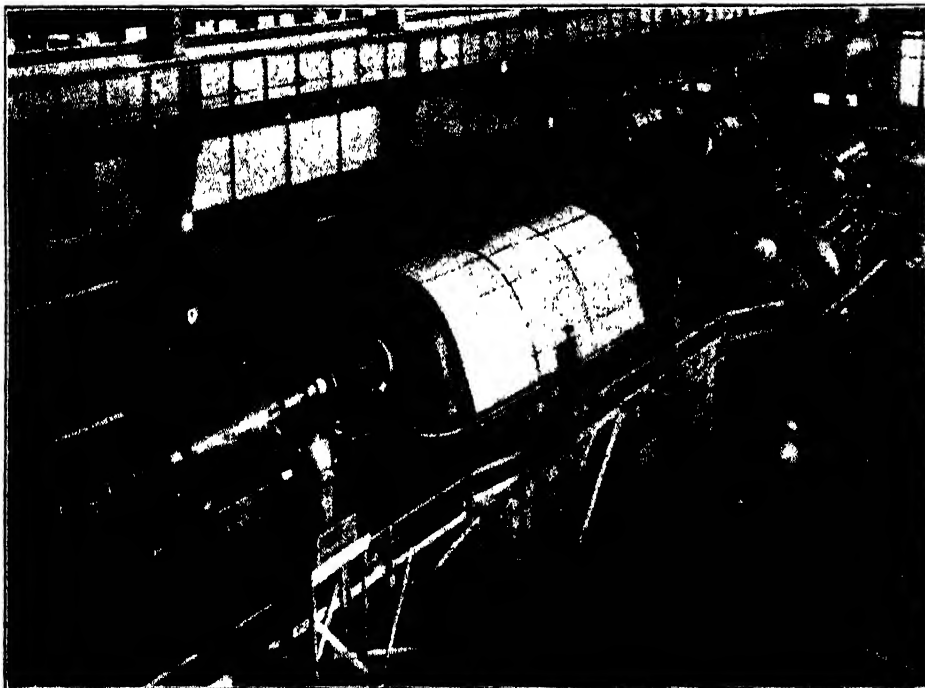
Rather inclined to turn up her nose with haughty indignation, this camel is being fumigated at Hamburg, Germany, before embarking for the United States. The entire body of the camel is enclosed in a huge caisson, hermetically sealed and with only the head showing. A chemical is then shot into the caisson in order to kill all the vermin on the animal



Wide World

◀ PHONOGRAPH AUDIOMETER

A new device developed by the Bell Laboratories for the quick and efficient testing of the hearing of public school children. The illustration shows J. B. Kelley demonstrating the apparatus at the recent Parents and Teachers Exposition in New York City. Only a short time is required to test a group of 75 pupils



WORLD'S LARGEST TURBO-GENERATOR UNIT

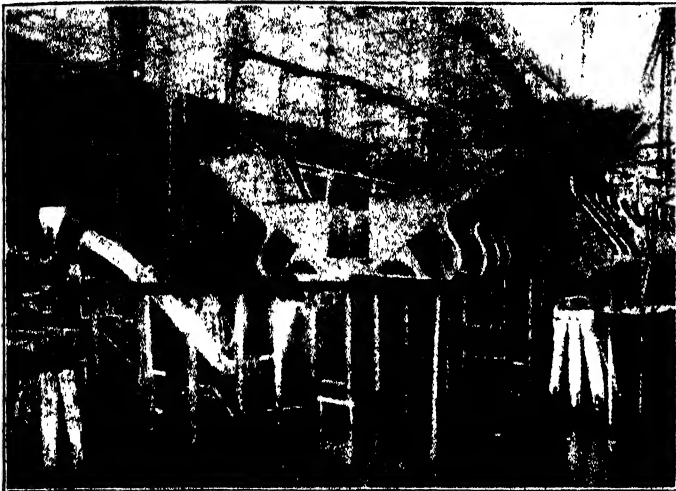
Generator unit for the Long Beach, California, plant of the Southern California Edison Company, having a rating of 94,000 kilowatts, as it appeared when set up in the shops of General Electric Company, Schenectady, New York, for the final complete tests. It was placed in commercial operation during the summer



Underwood and Underwood

TO STUDY SLEEPING SICKNESS

Dr. Warren K. Stratman-Thomas who went to Africa in October to study sleeping sickness under the auspices of the University of Wisconsin and the Guggenheim Memorial Foundation. This disease, carried by the tsetse fly, prevents development of many large parts of Africa



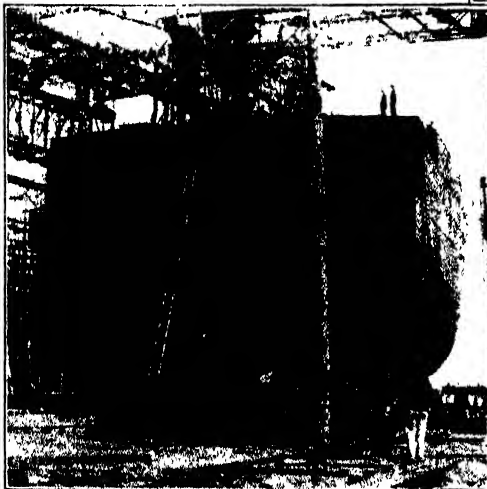
Underwood and Underwood

SHIP STABILIZERS: WAVE BREAKERS

Early construction work on the German steamship, *Bremen*, which was recently launched, showing the longitudinal bulges (not covered at this stage) which are designed to prevent side rolling. The *Bremen* is 937 feet long

LAUNCHING HALF A SHIP

Below is shown the new fore-end which was recently launched at Queen's Island, Belfast, Ireland, for the *Lochamona* which ran ashore last year. In order to prevent her becoming a total loss, about 150 feet of her fore-end was cut away at the time. At right is shown the after part.



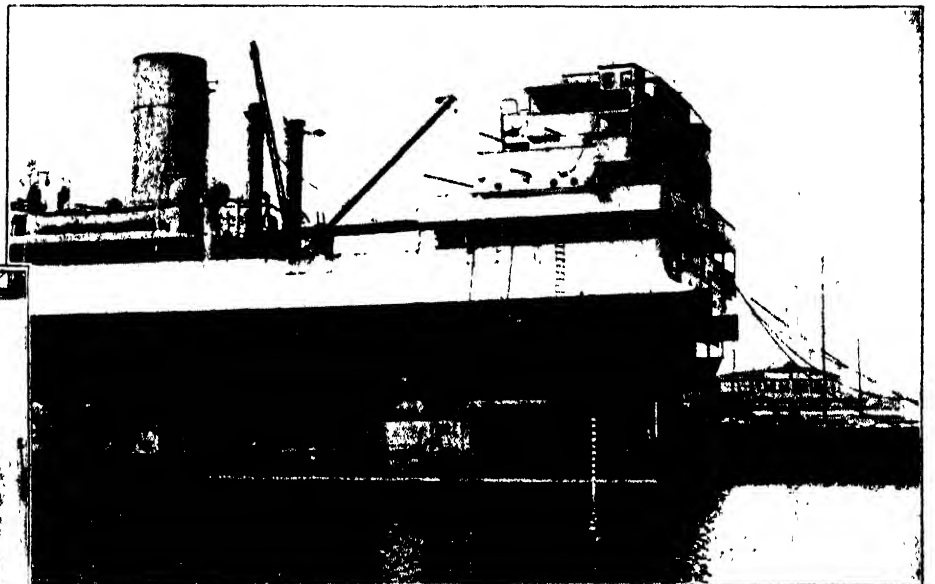
P and A



P and A

BEGINNING A HUGE GAS TANK

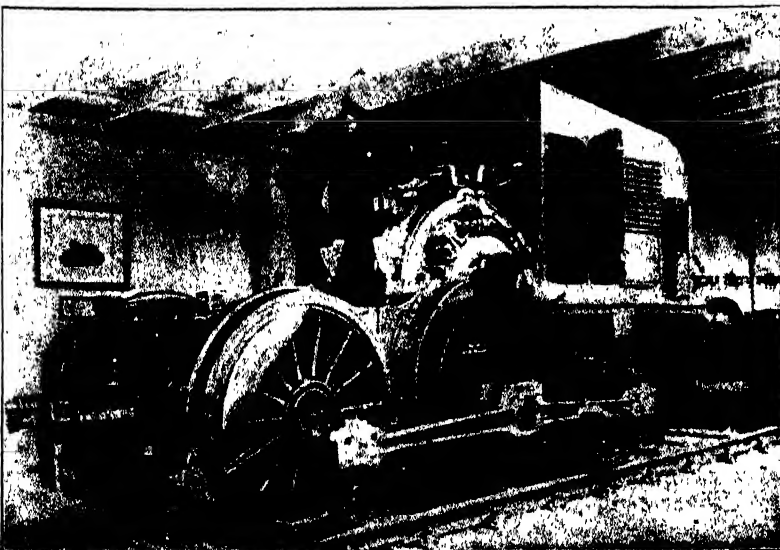
An army of workmen, each manning a jack, placing the foundation, at Norfolk, Virginia, of one of the largest gas tanks ever built. It is 180 feet in diameter and when completed will hold a gas supply of 3,000,000 cubic feet

**▼ ELECTRIC SWITCHING ENGINE**

This small but powerful tractor switching engine is used by the German National Railways. It is designed for use on flat lands and can pull heavy loads where grades are slight

▼ RAILROAD CAR SCHOOL

To reach scattered settlements in Canada, the Canadian Pacific Railroad supplied this school car. The teacher travels with the car, which stops a few days or a week at each place



Rothberg



There is a Lot to Just Sitting or Standing

Anatomical Studies Show that Man Has Not Yet Become Adapted to the Erect Position. His Everyday Working Efficiency is Governed by His Posture

By DONALD A. LAIRD, Ph.D., Sc.D.

Professor of Psychology and Director of the Psychological Laboratory at Colgate University
Editor, Industrial Psychology

A MANUFACTURER wanted me to size up chairs for him, to help select ones which would eliminate all possible fatigue. I have just finished working through more than 150 hard-to-read scientific reports on posture in an effort to give him the help he wanted—and also partly so that I could sit better and stand better myself. With his per-

sistently walks in the vertical position. Bears walk in this upright position from time to time, and once in a while some birds, such as the penguin, strut around in this position, but man is the only one who sticks to this position through thick and thin.

I would advise my neighbor against training his dog to sit up or walk on his hind legs after all this reading.

If using this vertical body position is as hard on the dog as specialists say it has been on man, my neighbor would actually be cruel to his pet.

Man, from this point of view, is an animal built internally for living with his trunk in a horizontal position parallel with the surface of the earth, but perverse habit makes him go against the way Nature intended him to go, and thus he walks upright, with his trunk perpendicular to the surface of the earth.

DR. ALES HRDLICA, the distinguished anthropologist of the Smithsonian Institution, has aroused a great deal of interest during the past few months in his collection of modern instances of boys and girls who have walked around on all fours like little kittens until they were so old that their parents were actually worried in many cases.

These children offer additional evidence that man was designed as an engineering product to go around horizontally, but he preferred to become upright.

There are valves in our veins, for example, which function best when we are in the horizontal posture. If we walked on all fours the appendix would not clog up and precipitate a hospital bill. The colon has to work against gravity in the upright trunk. There is more danger of brain hemorrhage in the vertical position of the

trunk, as well as increased susceptibility to varicose veins.

Man has been changed in appearance by his upright position. It has given his spine two curves, so that it resembles an elongated letter "S" while other animals have a spine with a single curve resembling a stretched-out "C."

THE reverse curve we have acquired in our spines makes it easier to balance the trunk on the big femur bones of the leg, by moving the center of gravity of the trunk back a few inches. The year-old child has only the single curve in its spine, but as soon as it begins to walk the additional curve makes its appearance.

Big feet, stronger heels, arches developed, and a larger great toe are the price we have to pay at one end for



THE "C" CURVE OF THE SPINE

Man's—and woman's—posture is normally erect but many workers slump, believing it rests them. It fatigues them.

mission I am letting you see my report to him.

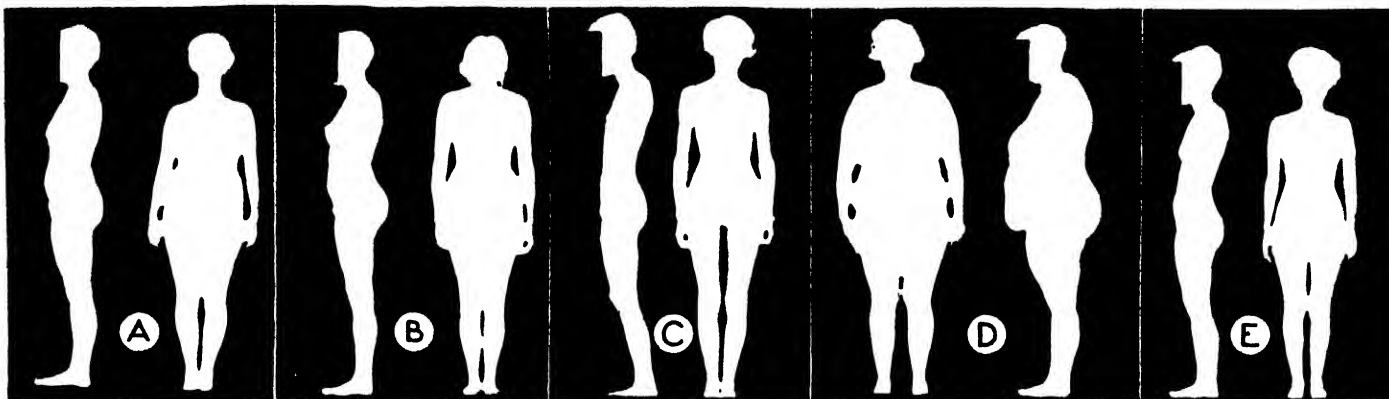
I was astonished to find that in order to sit or stand scientifically I had to know something about bears, penguins, babies' spines, and how 65 percent of the geniuses of the world have worked. I also made the great discovery that man is the only animal which spits, and that this is due to his posture!

There is no other animal which



THE "S" CURVE—CORRECT

Study of the anatomy of ancient man suggests that modern man's doubly curved spine is a recent acquisition in his evolution



Courtesy Journal of the American Medical Association

SILHOUETTES SHOWING TYPICAL POSTURES MET WITH BY THE FAMILY PHYSICIAN

A shows a fairly good body poise; B is good, C is a typical consumptive chest; D shows displaced internal organs. A typical slouch posture is shown at E. Physicians experience considerable difficulty convincing patients that bad posture is often a cause of bad health

this erect posture. At the other end of the body there have been one or two outstanding advantages resulting from man's typical posture. The range of vision and hearing was enormously increased, while the lower animals still depend almost entirely upon smell and taste. The drainage from the brain is vastly better, due to the upright position of the body. The bony sinuses are drained better, however, in the horizontal position and as a result of walking and sitting upright man has brought on conditions which encourage sinus infections, the most painful infection that can be experienced. Diseases of the ear and mastoid are also aggravated in man.

Within the trunk itself we discover that the upright posture encourages all our mysterious and important "insides" to sag an inch or more, encouraging rupture, displaced kidneys and bladder stones. Great strain is also thrown on the heart, and lung action is restricted, favoring the development of tuberculosis.

My first impulse was to recommend, in view of all these disturbing findings, that work benches be removed and workers told to work on their hands and knees on the floor. It would probably be wiser, however, to help them in order that they may know how to relieve all this strain which man's

evolution has placed on them. There seem to be some clear cut and generally accepted principles which can serve as guides, in a field which has been flooded with a great deal of faddist propaganda.

Posture is an active thing. It is produced by the co-operation of a great number of simple nerve reflexes - although these are not yet perfectly developed in our present stage of evolution. As a result, posture needs some voluntary help, since nature is not perfectly equipped to take care of it without a little intentional assistance.

POSTURE is a fight against gravity. An exact percentage of good posture can be obtained by measuring one's length while lying down and dividing this by the length when standing up. If one habitually wins the posture fight with gravity he will be as tall standing as he is lying down.

Gravity pulls organs in the body cavity downward. If gravity rather than posture wins the fight the waist measure will be larger than the chest. Chest circumference should be 10 percent greater than that of the belt line.

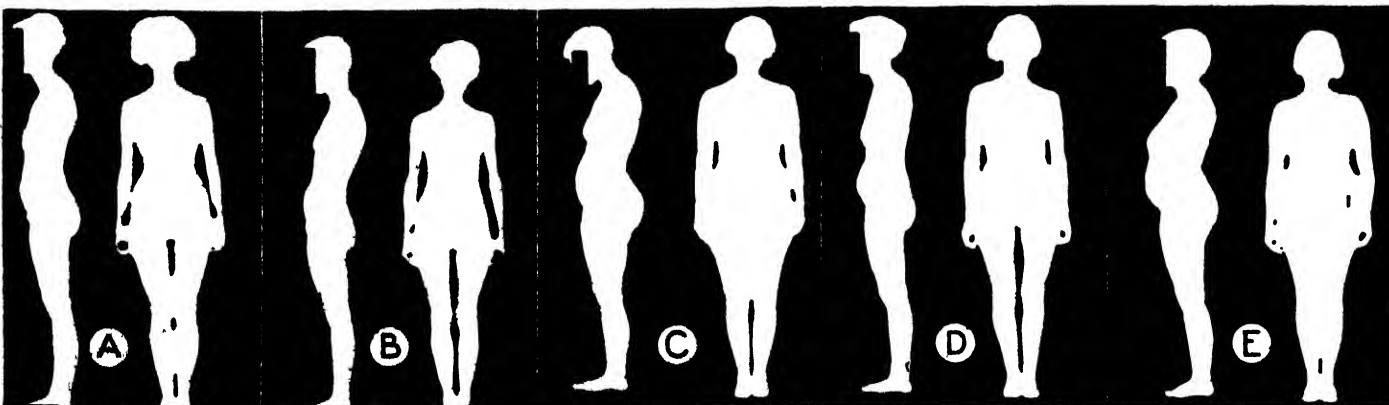
The curve should be kept in the small of the back. This can be tested readily by standing naturally with back to the wall; if the posture

is right the hand should fit snugly between the small of the back and the wall. Tall, slender people should give most attention to posture as their build makes them especially prone to bad posture.

There is the kangaroo type of posture in which the upper part of the trunk is in front of the line of gravity and the legs are behind this line. The gorilla type is just the opposite. In both instances the trunk is not nicely balanced on the center of gravity and there is a constant strain to keep the body from falling forward or backward.

Whether posture is "good" or "bad" there is a continual struggle of muscles to keep the body from succumbing to gravity. This may be such a habitual strain that we are not aware of it. Thus it is doubly insidious. Just standing may become very fatiguing for this reason. So will sitting, unless mechanical support is provided by the chair in order to relieve the strain of the balancing muscles. When standing for a long time is absolutely necessary, the habit should be formed of carrying the body weight on the ball of the foot, rather than on heel or toe, and rests should be taken intermittently by flexing one leg and allowing the other to carry most of the body weight.

In practically all jobs, however,

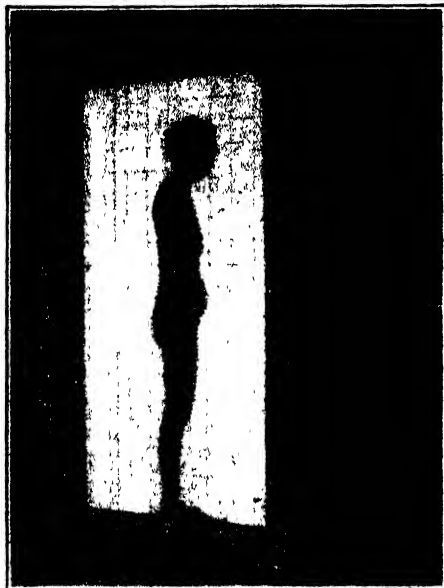


Courtesy Journal of the American Medical Association

MORE SILHOUETTES, SHOWING SEVERAL TYPES OF POSTURE COMMONLY OBSERVED

A slouches, while the others are familiar to all of us. B is thrusting out the abdomen. C is doubtless a desk worker, the head being bent forward; D has one raised shoulder, but E stands in an erect military posture. Good posture is acquired only by intentional effort

arrangements can be made so that work can be done while either sitting or standing. Changing from the one position to the other is genuinely restful. Even office desks and chairs have been arranged so this can be



Courtesy Journal of the American Medical Association

SILHOUETTE TUNNEL

In obtaining the silhouette the shadow was projected on an illuminated screen

done. Continuous sitting appears to be as undesirable as continuous standing.

If the sewing or assembly bench is raised about ten inches higher than is customary, and chairs are made with legs correspondingly longer and provided with a foot rest, it is possible for the worker either to sit or stand and save a great deal of fatigue through these changes in his position.

SPECIAL attention should be given to the chairs or stools. They should be of such a height that the sitter's feet can rest on the floor easily and squarely. When a stool is used it should be provided with a real foot rest; the rounds if used as foot rests cause the legs to be drawn back into a cramped and fatiguing position. Since people vary in leg length the height of the chair or foot rest should be easily adjustable.

A fairly serviceable way of telling whether the height of the working surface is about right is to hold the hands palms up, let them swing idly at the side and come to rest about a foot in front of the body. The knuckles should just touch the working surface. There are a very few people with long arms and short body trunk for whom it is almost a mechanical impossibility to sit and work without being in a bad posture.

The seat of the chair or stool should be moulded to fit the natural curves of the body. An ingenious efficiency engineer has recently modeled a chair seat by having all his friends sit in a

block of modeling wax so that he soon obtained a composite picture effect to serve as a guide. There is no particular advantage in an upholstered chair seat unless it has deep springs—which office and factory chairs seldom have. A saddle shaped chair is better than one with an inch of upholstery. A ventilated chair seat is also to be desired.

ONE can sit on a soap box and conquer gravity, but only with considerable effort. There should be a specially designed back rest. A rather narrow rest which will fit into the small of the back and bear gently forward is recommended. This is the same effect as when posture is measured by standing with the back to the wall and the hand passed between the wall and the small of the back. The height of this back rest should be adjustable so that the chair will fit both tall and short people. The seat should be narrow enough so that the sitter will be thrown back against this back rest, whether he wants to or not. The narrow width seat will make a gravity-tension-relieving-posture fairly automatic.

To prevent constricting the blood vessels under the knee, the front edge of the seat should be gently rounded. The foot rest also helps to avoid this congestion which will affect nerve as well as blood supply in a poorly designed chair and produce the effect of putting one's leg to sleep.

Attention to posture will not cure all the ills of man; the tensed machine-like posture of the West Pointer is beautiful to watch but may be carry-

ing the idea to extremes for the sake of military aims. But since man is built essentially as a horizontal animal, special attention is desirable for his fatigueless and efficient working in the vertical plane.

William James, the first psychologist at Harvard, observed 30 years ago that there is a redundant effect in posture, the firmly erect posture keeping up spirits, and making it difficult to entertain fears, despondency, and depressing thoughts.

Modern psychological investigation is confirming Professor James' keen observation, and a possible explanation of the why of this redundant effect is emerging. The great physiological background for our emotional lives seems to arise from the vaguely perceived internal sensations caused by visceral tensions. We are never directly aware of these visceral sensations—even a stomach ache does not come from where we feel the pain. We react unconsciously to many of these internal sensations by ups and downs in mood.

DRUGS or disease may alter the normal tension balance of the internal organs, and the emotional changes these bring about are a matter of everyday observation. Now it is becoming apparent how posture may also change the balance of the internal organs, and with these visceral tensions minor emotional ailments may be started.

Human beings are not born with good posture made natural for them. While it is not original nature to have correct posture, it can be made second nature by training in good posture habits.



FACTORY WORK IS SLOWED DOWN BY BAD POSTURE

Here are factory stools which have been fitted with home-made back rests, but none of the workers are using them properly, all the workers' backs having a "C" curve. Also there are no foot rests

It Reknits Hosiery

Run-Repairer Is Worth Millions

A GASP of dismay bursts from the lips of the wife. The husband looks up startled. Only some extraordinary catastrophe could call forth such a devastating outburst from the little woman who usually is so placid, refined and self-possessed. She continues.

"Look at that stocking! Hopelessly ruined! Just bought today. Six dollars for the pair and now I catch them on a splinter on that chair I've asked you again and again to fix. Why doesn't somebody invent a machine to repair the runs in stockings?"

That speech was made at least sixty million times in the United States last year. With stockings becoming more and more sheer, and skirts shorter and shorter, runs have been taking on an ever-increasing importance.

SUCH is the situation which influenced two brothers to refuse a million dollars each for the patent rights to an electric machine which they have invented to repair the broken stitches in silk hosiery. Instead they have accepted a substantial number of shares in a new corporation to be organized by the Gotham Company for the sole purpose of repairing runs. The value placed on the invention, upon which six patents are pending, is between 15,000,000 and 20,000,000 dollars.

Repairing the ladder-like runs in stockings is fascinating. A latch needle is used; this is a hook-like device, which by proper movement is converted automatically into an eye,

offering no sharp hooks or points to tear out or unravel additional stitches.

With the new Knitbac machine it is all done electrically. You insert the needle in the last perfect loop of the broken thread. This loop hangs on the needle's shank, the thread to be looped being placed in the hook. As the needle descends, the loop on the shank comes up and forces the latch closed, making an eye. It then folds down until the thread caught in the hook is pulled through the fabric. As the needle rises again, the hook opens and the process is continued until the original thread is looped back into the fabric. When next the stocking is worn, the most critical observer



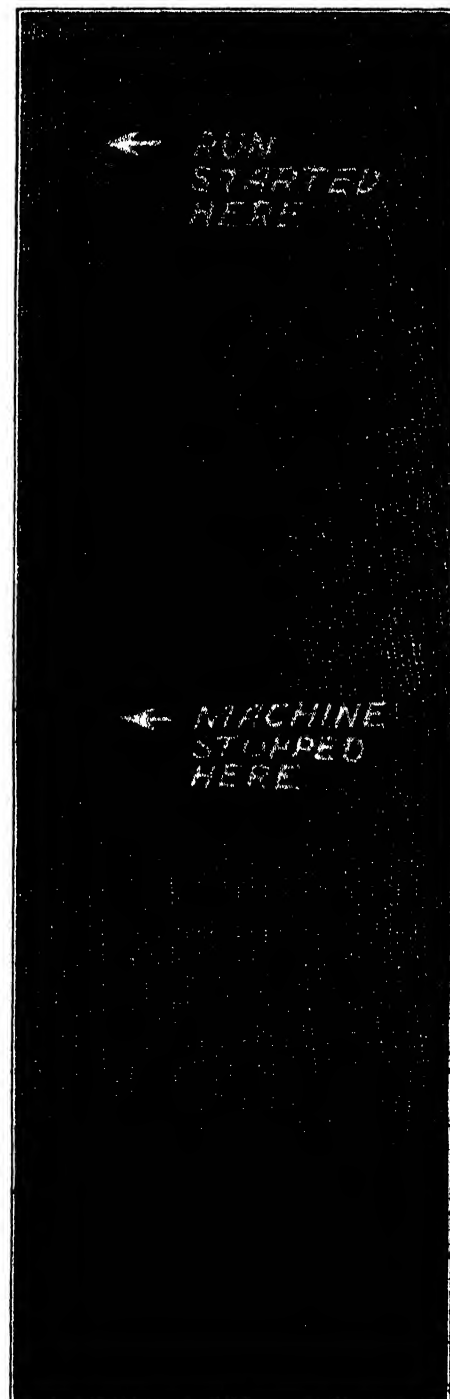
LIKE LIGHTNING FINGERS

Swiftly the machine opens and closes, pulling the thread through until its task is done



THE OLD WAY AND THE NEW

The young woman on the left can repair runs by hand as effectively as can her companion with the newly developed machine, but it takes her twelve times as long to accomplish the task



BEFORE AND AFTER

Rewearing the stocking wipes out completely all trace of the ugly ladder-like run

will fail to see that it ever has been repaired.

Lest the stocking should slip when being repaired, a toothed gauge holds it firmly in place. Should a mistake be made an automatic brake stops the operation. It is said that by the use of the machine, runs in stockings may be repaired ten or twelve times as rapidly as by the old hand method.

Samuel and William Leavin are the inventors. As proprietors of a little shop selling novelty hosiery, they worked out an idea for a machine, convinced the Gotham Company of its value, and were financed for five years while they perfected their device.

Wave Atoms*

A Scientist Explains Further the Inwardness of the New Schrödinger Atom Concept

By PAUL R. HEYL, Ph.D.

Physicist, United States Bureau of Standards
Corresponding Editor, SCIENTIFIC AMERICAN

A WAVE ATOM

An attempt to depict the concept of the variation in electric density in a sphere. At instant chosen it is greatest at the center

"I'VE come back, you see," said the visitor.

"Yes, I remember you," said the scientist. "You came here some time ago, asking me to show you an atom—which I could not do."⁽¹⁾

"But you did show me something worth seeing, and in so doing you started something; you set me thinking."

⁽¹⁾SCIENTIFIC AMERICAN, July, 1928

The New Atom

IN a previous article which was widely quoted and commented on by other journals, the author, Dr. Heyl, told us how scientific styles in atom concepts changed from time to time as new experimental evidence forced their revision. Science is never a settled thing. It is in a state of constant flux. It evolves. When science becomes finally "conclusive," fixed and settled; when scientists at last "know it all"—then science will be dead.

The new atom concept of de Broglie and Schrödinger—better known among physicists as the new wave mechanics—is still an infant of three. More will be heard of it when it is a little older. As Dr. Heyl says, even the professional physicist is still a bit vague about it—still going to school on it. Perhaps something like the following will happen: the new atom will reach the newspaper and general public stage of discussion in a year or two. Before then, readers of the SCIENTIFIC AMERICAN will no doubt wish to acquire a working knowledge of it. The available literature, excepting that suited only to the real 32nd-degree "math. shark" and physicist, is not large. A semi-popular paper by Dr. C. J. Davisson of the Bell Telephone Laboratories in New York, entitled "Are Electrons Waves?," appeared in the May, 1928, issue of the *Journal of the Franklin Institute* (Philadelphia); another semi-popular paper by Dr. Paul R. Heyl, in *Scientific Monthly* (New York) January 1928. Also see *Physical Review*, December, 1927.

—The Editor.

"That I would not willingly stop," replied the scientist, smiling. "But what brings you back today?"

"Well," said the visitor, "You spoke of the very latest mode in atomic fashions—the Schrödinger wave atom; and the more I think about it the less I understand it. To begin with, a wave presupposes something which undulates. What is it that undulates in the atom?"

"I can't exactly say," replied the scientist.

The visitor grinned.

"You play a good defensive game," said he. "I expected you to say 'electricity,' and then I was going to corner you and ask 'what is electricity?' But you perhaps see my difficulty," continued he. "The whole thing has impressed me as a piece of pure speculation, and rather a hazy one at that. Is not that all that it is?"

"That is all that it was at first—pure speculation."

"And what is it now?"

"We may regard it at least as a lucky guess, if nothing more, for there has recently been brought forward a piece of experimental evidence which indicates that atoms (or rather, electrons shot out from atoms) are of a wave-like nature."

"Really?" said the visitor. "That alters the state of things. I see you can attack as well as defend. You have hit my weak spot. I may be called credulous, even gullible, but I am ready to accept anything on experimental evidence—if there is no simpler explanation."

The scientist nodded approvingly.

"That is the right scientific attitude—the simplest explanation that fits the facts of experiment. Only sometimes the simplest explanation is rather complicated."

"Tell me more about this," said the visitor. "How is one to know whether an atom—a thing which no one has ever seen—is really a little bunch of waves or a tiny particle of—of something or other? What is the line of

*Publication approved by the director of the Bureau of Standards of the U. S. Department of Commerce.



ANOTHER CONCEPT

We might assume that the vibration within the Schrödinger atom was broken up into segments, for example, like the one shown

attack to follow in such a case?"

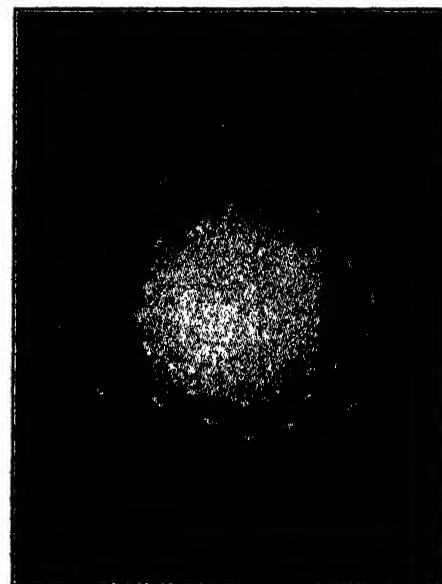
"In general outline, much the same as you yourself would follow in attempting to form an estimate of the character of a stranger. You would judge him by his actions. So we judge the nature of an atom. If, under conditions where the behavior of waves and of particles are quite different, an atom acts in a wave-like manner, we form our judgment accordingly."

"And anyone would say that you were drawing the only possible conclusion. But go on, please; tell me more. What are the particular conditions that enable one to discriminate between waves and particles?"

"For one thing, reflection from a smooth surface."

The visitor thought for a moment.

"Do not waves and particles act pretty much alike on reflection? I know that a beam of light waves is reflected from a mirror at the same angle by which it approached it; and is not the same true of the rebound of elastic balls? I cannot think at the moment of any difference in the be-



Courtesy the Smithsonian Institution

X-RAY DIFFRACTION PATTERN

X rays falling on a crystal of magnesium oxide are reflected at uniform angles.

havior of light waves or particles on reflection."

"Perhaps not," said the scientist. "I was referring not to light waves but to X rays. Their behavior on reflection may be quite different from that of light waves—or of particles."

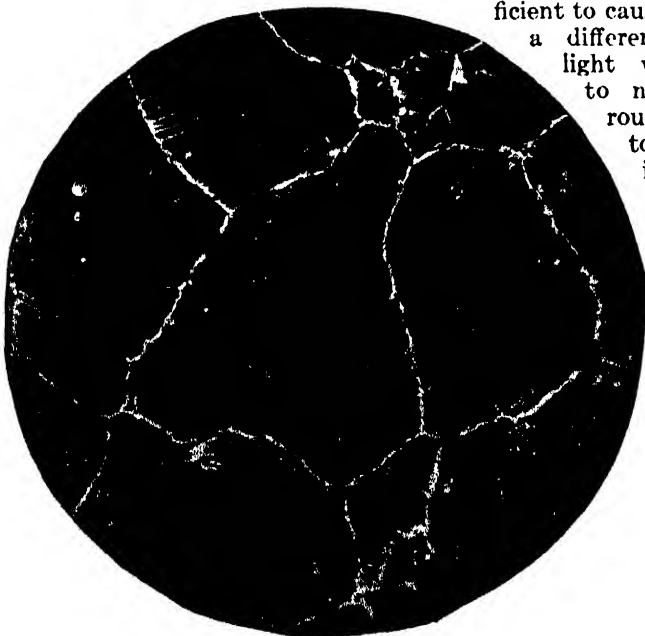
"THAT is something with which I am not familiar," said the visitor. "Of course, I know that X rays are now recognized as waves, something like light, but much shorter in wavelength—10,000 times smaller, aren't they?"

"Something like that. But a little acquaintance with the laws of reflection of X rays is necessary in order to understand the force of the newly discovered evidence for the wave-like nature of the atom. And it is rather a long story."

"Go on, please," said the visitor. "You have started something again; you have aroused my curiosity."

"Well, to begin with," said the scientist, "the nature of the mirror that reflects X rays has much to do with the way in which they are reflected." He picked up a small polished slab of metal from his desk. "Here is a piece of steel which has had one of its faces (the top) etched by acid. Notice the difference between the top and bottom faces."

The visitor turned the block over



ALSO ETCHED

The same steel was heat treated at 1100°, Centigrade, and cooled. Magnification 250 diameters. Note increased size of crystals

in his hand. Its lower face was smoothly polished; its upper face was equally smooth to the touch, but was covered by a mosaic of little patches, roughly geometrical in shape, some brighter and some darker than others.

"Use this glass to look at it," said the scientist. "Steel, or in fact any metal, is made up of a mass of closely

packed crystals, small and large. This structure is not apparent on the polished face, but can be brought out by etching with acid. A beam of light reflected from such a metallic surface behaves in the same way as it would if the surface had been that of water or any other reflecting material; but a beam of X rays reflected from this slab of metal would be scattered in all directions."

"That is strange," said the visitor. "What is the cause of it?"

"Difference in wavelength, principally," answered the scientist. "Light waves are many times greater in wavelength than X rays, which are comparable in size to atomic dimensions."

"THE difference is something like that between a man and an ant. To a man, a smooth sandy beach is a flat surface, a suitable place for establishing speed records. To an ant it is a rough and stony desert. Such extreme conditions are sufficient to cause quite

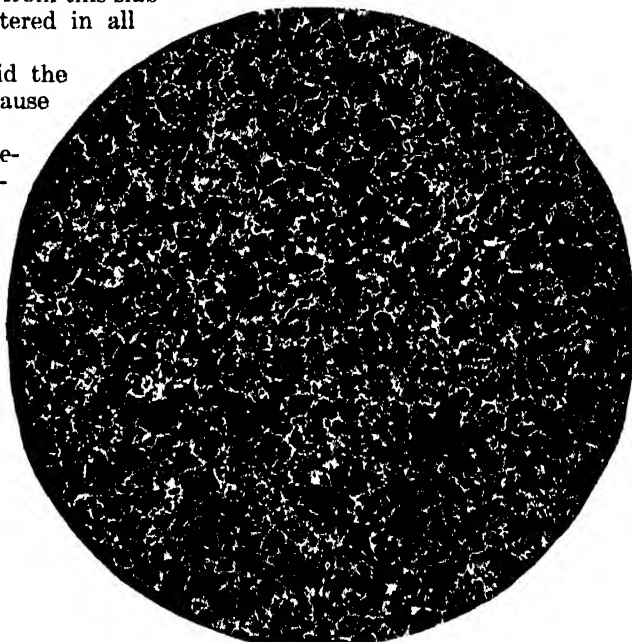
a difference in behavior. The light waves are big enough to neglect the molecular roughness of a surface, and to behave after reflection in a dignified and geometrical manner, while the tiny X rays encountering the same obstacles are put to confusion."

"And we must also consider the fact that the X rays can penetrate metals and opaque bodies to a considerable depth. This exposes the more to the disturbing influence of molecular structure. But curiously enough," went on the scientist, "if we confine the incident beam of X rays to the face of a single crystal, like this

one," (and he pointed out on the etched surface a bright area nearly a quarter of an inch square) "the rays are then regularly reflected instead of being scattered in all directions."

"But," said the visitor, "how does that square with what you have just said about scattering being due to difference of size of the waves?"

"Regularly reflected," continued the scientist, "but not after the manner of light waves. When a ray of light of a single color (that is, of a single wavelength) falls upon a mirror it is always reflected in some direction, no matter what the angle of incidence may be; but if X rays of a single wavelength



ETCHED STEEL

A piece of 0.5 percent carbon steel heated for six hours at 850°, Centigrade, and air cooled. Magnified 250 diameters

strike a crystalline face there will be little or no reflection unless the angle of incidence is just right."

"There is nothing like that in light waves," said the visitor, thoughtfully. "What determines whether the angle of incidence is 'just right'?"

"The nature of the crystal and the wavelength of the X rays. It is as if a mirror of silver would reflect red light only at an incident angle of 40° and green light only at 60°, while a mirror of brass would reflect the same rays only at angles of 30° and 50° respectively."

"THAT is something I cannot understand," said the visitor. "It is recognized—is it not?—that X rays and light waves differ only in degree—that is, in wavelength? But their behavior after reflection seems to differ in kind."

"That is rather hard to understand, I admit; but we must remember that it is this difference in degree of wavelength that is one factor in permitting X rays to penetrate metals, thereby bringing about a different kind of environment from that of the light waves, which scarcely penetrate the surface in being reflected, and can hardly be said to have time to find out what the reflector is made of."

"I see," said the visitor. "The light wave keeps to the surface, like a rebounding ball; the X ray gets some

distance below the surface before it is turned back."

"Exactly," said the scientist. "Although there may be little difference in the behavior of reflected light waves and rebounding particles, there is no possibility of confusing particles with X rays."

"I can guess what you are coming to," said the visitor. "Electrons behave like X rays."

The scientist smiled and nodded.

"YOU are a good guesser. That is what Davisson and Germer have recently discovered."⁽²⁾

"But electrons have been known for many years, and there must have been a great number of experiments carried out which involved their reflection. How did it happen that this peculiar behavior has only just been noticed?"

"By accident. Many such experiments have indeed been made, but naturally on pieces of ordinary metal like this," and he pointed to the etched slab of steel. "From such a reflector made up of many small crystals, electrons are scattered in all directions. And this is just what Davisson and Germer were doing when they made their accidental discovery. They were studying the distribution of the electrons rebounding from a target of nickel. The whole apparatus, of course, was enclosed in an evacuated glass bulb. It happened that the glass broke and the intruding air coated the hot target with a film of oxide. To clean it from this tarnish it was heated for some time in hydrogen. After

setting up the apparatus again in a new bulb, the experimenters were surprised to find that the reflection of the electrons from the cleaned target had become regular."

"And the only difference was the heat treatment that the target had suffered in the mean time?"

"That was all."

"What did that do?"

"Metallurgists have long known that by suitable heating, straining or annealing of a metal, the crystals of which it is built up can be considerably increased in size. Examination of the nickel target showed that this is what had happened. During the prolonged heating involved in the cleaning process, the crystals of nickel had grown so large that it was almost a case of reflecting the electrons from a single crystal instead of from many. This greatly altered the distribution of the reflected electrons."

"WHEN this fact became clear, the key to the situation was in the hands of the experimenters. They produced as large a crystal of nickel as they could, and studied the behavior of electrons reflected from it. In every particular the reflected electrons behaved in a manner similar to that of X rays."

"Do you mean to say," asked the visitor, "that the angle of incidence has to be just right before an electron can be reflected?"

"Approximately speaking, yes."

"But what determines that angle?"

"It appears that the speed of the electron has much to do with it. The speed seems in some way to correspond

to the wavelength of X rays under similar circumstances. The greater the speed the shorter the corresponding wavelength. If an electron is a particle this is incomprehensible; but if it is a little bunch of waves it is much easier to understand. We have only to suppose that the waves of which it is made up travel with speeds which depend on their wavelength, the longer waves traveling more slowly than the short ones."

"Are there any known waves that do that?" asked the visitor.

"YES and no," answered the scientist. "There are plenty of cases, such as light waves in glass, or deep-water waves; but the difference is that they do it the other way about. Their long waves travel the faster. And in free space (to which the interior of an evacuated tube is a good approximation) all waves of light travel with the same speed."

"Then if electrons - and atoms - are waves, they must be of a different nature from light waves?"

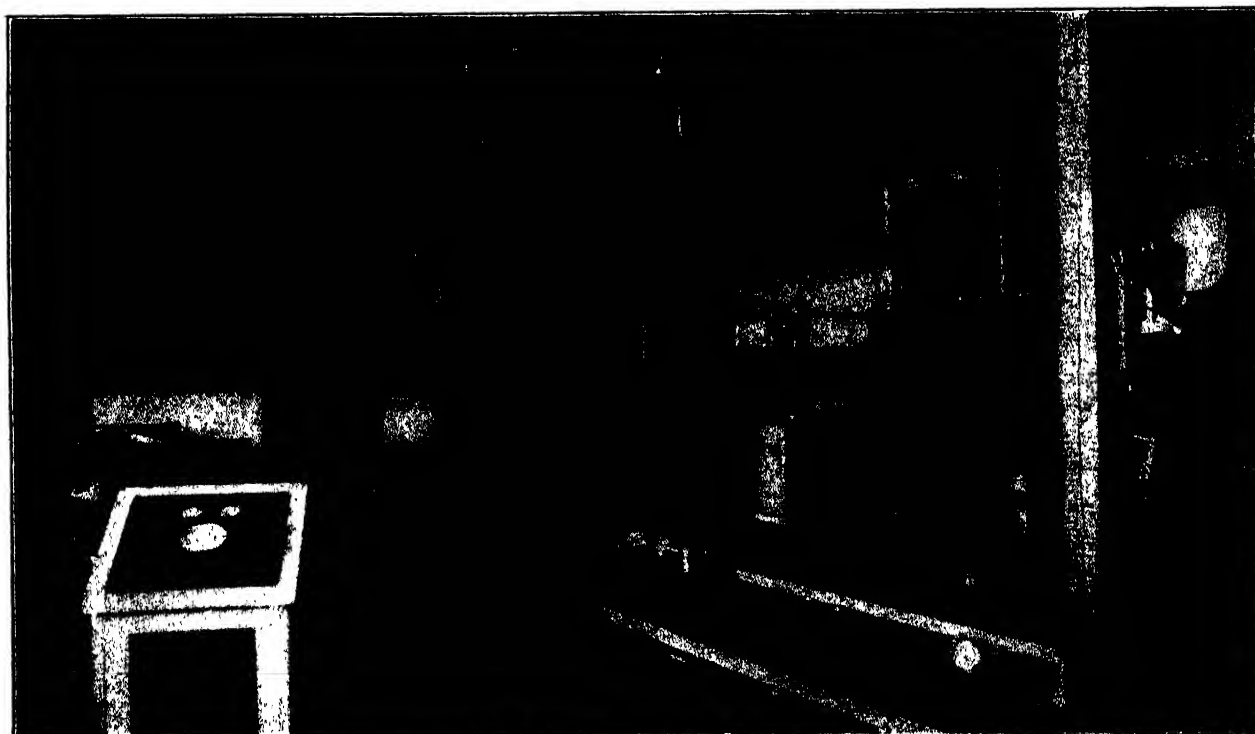
"Either that, or they must be carried by a different medium."

A slow smile spread over the visitor's face.

"I see," said he, "that you had your wits about you when I asked you what was vibrating in the atom. You did not say it was the ether."

"No," said the scientist, smiling in return. "I did not feel warranted in saying that. We do not know much about that aspect of the subject. All we feel reasonably certain of is that an atom behaves more like a wave than a particle."

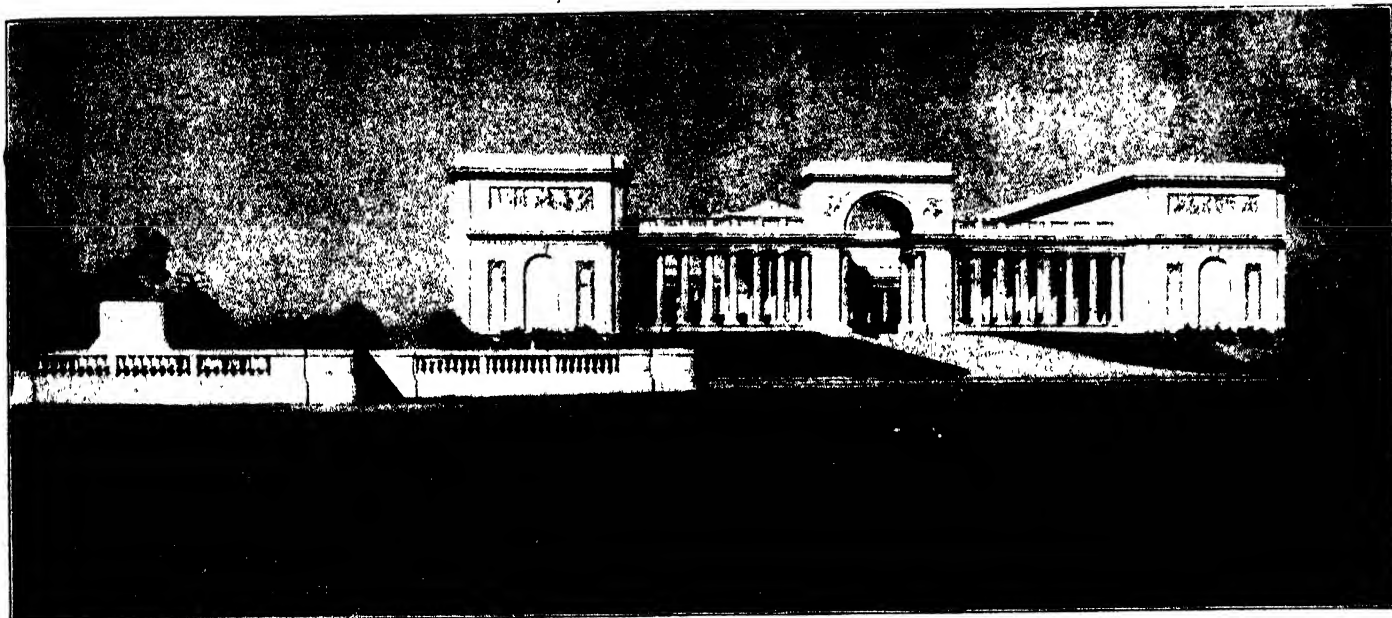
⁽²⁾Physical Review, December, 1927, Journal of the Franklin Institute, May, 1928.



A GENERAL VIEW OF THE X-RAY LABORATORY AT THE BUREAU OF STANDARDS

With such apparatus the behavior of X rays has been determined. For advanced technical accounts, see Philosophical Magazine, 47 (1924),

page 448—the first mention of the new concept; also Annales de Physique, 3, (1925) page 22 and Physical Review, December, 1927



THE CROWNING GLORY OF A SAN FRANCISCO HILL

Dedicated to the memory of California soldiers who fell during the war, and to the great purpose of advancing the knowledge of art and kindred subjects, the California Palace of the Legion of Honor surmounts a hill where it may be seen from all parts of the city and from the harbor

San Francisco's Memorial Museum

A Gift to the California City, This Magnificent Building Is a Replica of the Palace of the Legion of Honor

By CHARLES W. GEIGER and RUTH SABICHI

ON the summit of the highest hill in San Francisco, overlooking the Pacific Ocean and the world-famous Golden Gate, the magnificent California Palace of the Legion of Honor stands as a memorial to the California soldiers who fell in the World War.

This 2,000,000 dollar memorial, a replica of the Palace of the Legion of Honor on the banks of the Seine in Paris, was presented to the city of San Francisco by the late Adolph B. Spreckels and his wife, Alma de Bretteville Spreckels. It is intended first of all to honor the dead while serving the living; secondly, to establish and maintain in the city of San Francisco a museum and library of art; thirdly, to encourage and develop the study of the fine arts and the application of the arts to manufactures and practical life; and fourthly, to advance the general knowledge of kindred subjects, and to that end to furnish popular instruction.

THE California Palace of the Legion of Honor is expected to become a great educational center because of its art galleries, little theater, and specially designed organ.

The setting of this great palace-museum is most commanding and beautiful. There are few monuments in history which have had sites equal to this. Erected on ground given by the municipality of San Francisco, it stands in the magnificent frame of Lincoln Park and its beauty can be seen not only from all parts of the city, but from far out at sea. Far below on one side, lies the blue water of the Pacific. In the middle distance can be seen the Golden Gate, and to the right San Francisco, shimmering in the

sunlight, has the appearance of an Italian or a Spanish city. The building is surrounded by terraced gardens from which visitors may view the Pacific Ocean, the Golden Gate with steamers and sailing vessels from all ports of the world passing in and out, Mile Rock Lighthouse, stately Mt. Tamalpais across the bay, and the San Francisco harbor, the largest land-locked harbor in the world. Sunset from these terraced gardens is a sight long to be remembered. As the sun sinks into the horizon at sunset, the Golden Gate becomes truly one of gold.



IN THE GOTHIC PALM COURT

The "Smiling Angel of Rheims" stands here surrounded by a great variety of semi-tropical plants, by seats, and promenades

THE style of the California Palace of the Legion of Honor is French Renaissance of the period of Louis XVI, a style which lends itself well to the quiet, dignified treatment necessary for museums. Approaching the building, one's attention is attracted by the imposing statue of Jeanne d'Arc by Anna Hyatt Huntington, which is said to be the finest statue of the French martyr ever made. Behind the Triumphal Arch, which is surrounded by colonnades and which constitutes the entrance to the palace, extends the spacious Court of Honor, sur-



TWO FINE EXHIBITS

Above is shown a group of Egyptian antiquities presented to the museum by Adolph B. Spreckels, Jr. At the right may be seen two panels of the Gobelin tapestries depicting the life of Joan of Arc, a series of which was presented to the great museum by the French government.

rounded by Ionic columns prolonging those of the façade. In the center of the Court of Honor is Rodin's famous statue, "The Thinker." The Triumphal Arch, the surrounding colonnades, and the front wings of the Palace are flood-lighted at night by powerful batteries of flood-lights placed in the terraced gardens, presenting a most inspiring night scene.

The marble rotunda is the point of departure of the 19 long galleries in which are exhibited paintings, sculptures, engravings, prints, tapestries, and other works of art.

IN the center of the rotunda is the "Age of Bronze" by Rodin. There are two palm courts where antique fountains are playing, and semi-tropical plants and flowers abound. There are also attractive seats where visitors may rest after making the circuit of the galleries. One of the palm courts, known as the Gothic court, is ornamented with a doorway of the Church of Toul, and the Smiling Angel of Rheims, while the Indo-China court is ornamented with the low relief of the Temple of Ankor Wat.

One of the most popular features of the Palace of the Legion of Honor are the organ recitals given by Mr. Uda Waldrop on the pipe organ costing 150,000 dollars, which was the gift of John D. Spreckels. The main instrument is over the vestibule at the building's entrance and the echo organ is placed at the opposite end of the building in the "Tapestry Court."

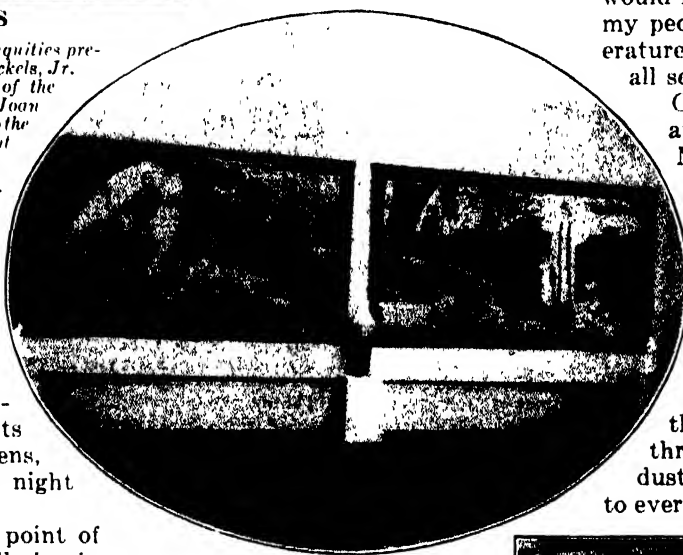
In the Triumphal Arch in front of the Court of Honor is installed a full set of chimes and also a fanfare of trumpets to announce the theme of the concert. These may be heard for several miles over the city and out at sea. The whole organ may be played either to the interior of the building or out into the Court of Honor and surrounding parks. There is an immense frieze over the entrance to the building representing "The Sacrifice." When the organ is to be played out into the Court of Honor, this frieze is raised by electric motor, thus permitting the organ to be heard clearly outside the palace. There are also special connections for the organ console in the Court of Honor permitting the console

government has generously given the museum 500 slides and a number of valuable books of the monuments, cathedrals, chateaux, et cetera, of France, to assist in this work.

Among the notable exhibits in this great palace-museum, the following may be listed as representative: a series of Gobelin tapestries depicting the life of Jeanne d'Arc—after the drawings of the painter Jean-Paul Laurens—and an important collection of about a hundred works of art from the National Sevres factory, all having been presented to the museum by the French government.

AUGUSTE RODIN is represented by a group of 32 pieces collected by Mrs. Spreckels, among which are "The Thinker," mentioned above, and "Saint John the Baptist." Mrs. Spreckels has lent her valuable collection of art objects to the museum. "I would rather have the knowledge that my people can enjoy the art and literature in the museum than to keep it all selfishly for myself," she said.

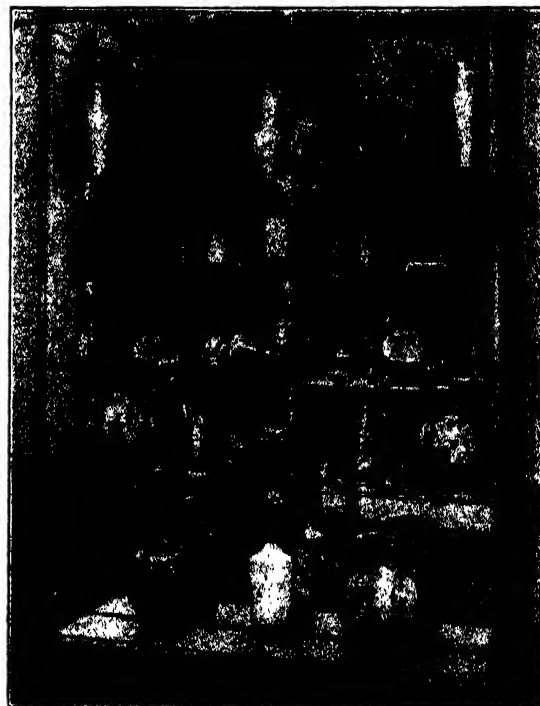
Constructed of concrete, stone, and steel, under the direction of M. Guillaume, aided by the American architect, Mr. George A. Applegarth, the museum is equipped with a perfect lighting system permitting of visits both day and night. The day lighting is brought in at an ideal angle for the various exhibits, and the night illumination is at the same angle. All of the air for the building is washed through a water screen to remove dust, and is then heated and carried to every part of the museum. An even



to be played from this point. The dome of the rotunda as well as the echo-organ dome is covered with airplane cloth so that the organ recitals may be heard clearly in every gallery.

On the terrace floor are the offices, library, tea-room, studios, and theater. The theater seats 250 persons and has a complete stage including the most modern electrical equipment. The ceiling has been decorated by Señor Jose Vilay Prades and represents Inspiration on the Wings of Pegasus surrounded by seven arts. The center design is the symbolic figure of a dead warrior. In this theater, lectures, concerts, moving pictures, and plays can be given.

A projection room, fully equipped with the latest moving picture apparatus, serves to further the educational work of the institution. The French



A QUEEN'S GIFT

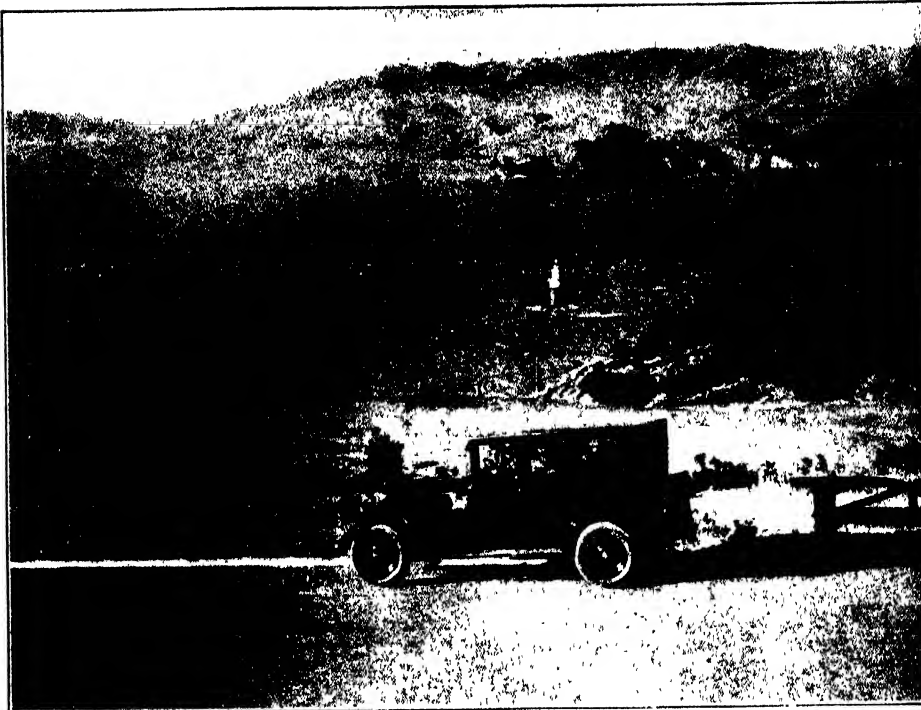
The Queen of Greece presented this beautiful collection of Greek vases to the new memorial museum.

temperature is maintained the year around, without visible radiators in any of the galleries.

While planning the building, inspections were made of many American museums and a careful study made of the plans of all European museums of importance. Built according to facts brought out by this study and exhaustive research on new problems, this edifice marks an advance in museum design and construction. Most of the European museums have been old palaces and civic buildings, while in America each museum has been a new creation carefully studied for the purpose of perfecting it in every detail of plan and equipment. Consequently, in America the improvement in this type of building has been very rapid in the last 25 years. It may be said in all truth that the California Palace of the Legion of Honor is the very last word in museum construction.

THE history of this palace-museum idea and of its realization, setting forth more forcibly than by any language the faithful friendship existing between two great republics, France and America, is worth relating. Its conception dates back to the Panama-Pacific International Exposition which was held at San Francisco in 1915. The French government had been invited before the war to exhibit there. Notwithstanding the fact that many difficulties had arisen due to the beginning of the war in Europe, France, upon the urgent entreaty of M. Tirman, Councillor of State—who had been appointed as Commissioner General for the French Government at the exposition—decided to be represented there.

In two months, with the aid of the



THE GOLDEN GATE FAR BELOW

Mile Rock Lighthouse, the immense hills across the bay, and the entrance to the harbor of San Francisco—called the Golden Gate—may be seen from the highway leading up to the museum

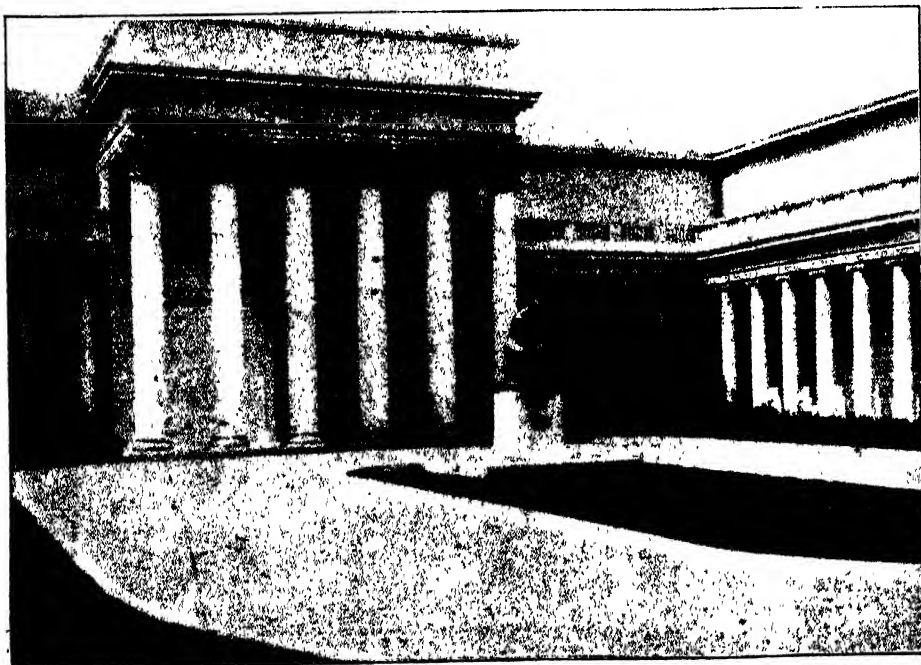
architect, Henri Guillaume, M. Tirman succeeded in causing to rise from the ground the French Pavilion, constructed of temporary material, a faithful reproduction of the Palace of the Legion of Honor. This effort of a country engaged in war, met with great acclaim, the more so that the various exhibits, instead of being scattered among different stands, had been grouped in the pavilion. These exhibits included numerous treasures borrowed from French museums and hundreds of specimens of the products of her principal industries.

It was at that time that two generous Californians who always cherished a love for France, Mr. Adolph Spreckels and his wife, Mrs. Alma de Bretteville Spreckels, conceived the project of erecting a permanent French Pavilion which should be used as a museum of art and culture. This project was interrupted by the entry of the United States into the World War, but was again entertained at the end of hostilities. Work was begun and the great building rose under the direction of the French and American architects but Mr. Spreckels did not live to see his dream come true.

Now completed, this magnificent edifice is dedicated to the memory of California soldiers who fell in battle during the war. It is a touching gesture of French-American fraternity.

THE palace-museum is free to the public every day, including Sundays and holidays. It is governed by a board of trustees of which Mr. Herbert Fleishhacker is President, and is maintained by the city and county of San Francisco. Since its opening it has been under the personal direction of Dr. Cornelia B. S. Quinton, Director, and Major W. W. Quinton, Curator.

The California Palace of the Legion of Honor, uniting the memory of common struggles to the peaceful aspirations of the present, will remain, according to M. Jusserand, French Ambassador at Washington, "the testimonial of the sentiments which have always united France and the United States in the days of calm as well as in the days of tempest."



THE COURT OF HONOR

Auguste Rodin's famous "The Thinker" surmounts a pedestal in this court which is enclosed by an Ionic colonnade. Batteries of powerful floodlights render this an inspiring scene at night

Wheels

By P. CORMAC
F. R. C. Sc. I., M. R. I. A.
University College Dublin

The First of a Series of Articles on the Mechanics of Wheels in Vehicle Suspension, Propulsion, and Steering, and the Gyrostatics of Wheel Wobble

THE wheel, without doubt, is the greatest invention in mechanical engineering. Its primary function is to substitute rolling resistance for sliding resistance in the transport of materials or vehicles. The moving of a heavy slab of stone across a road is made much easier by placing it on rollers.

To move an automobile weighing 3000 pounds along a level concrete road takes a pull of about 45 pounds, corresponding to 2.4 horsepower at 20 miles an hour; the car will coast or "freewheel" down a $1\frac{1}{2}$ percent grade. Without wheels, the vehicle would take a pull of 1500 pounds, corresponding to 80 horsepower at 20 miles per hour; the machine will not coast unless it be on a 50 percent grade.

The remarkable saving in power, arising from the use of wheels, is a direct consequence of the fact that the wheel brings the ground reaction to a

automobile, we have the load of the car applied to the wheel by the stub axle at A, Figure 1; the other force acting on the wheel is the reaction of the ground at the point of contact G. The equilibrium of the wheel, under the action of these two forces, requires that the direction of the forces be along the line between the points of application, that is, along the line GA. Hence the road reaction acts along the radius of the wheel, and, in consequence, at right angles to the road surface. It can therefore offer no opposition to the progress of the car.

WHAT might be called the First Law of the wheel, that wheels should be kept round, and tires fully inflated, thus follows from Euclid's theorem on the perpendicularity of the tangent and radius of a circle: "The straight line drawn at right angles to the diameter of a circle through its extremity is a tangent to the circle."

In practice, however, we get a slight resistance to motion, even with the best make of wheel. This resistance arises mainly from the fact that neither the axle nor the ground contact are geometrical points. The wheel does not touch the ground in a single point but rather over an area, which, with balloon tires, may be from 10 to 20 square inches. The imperfect flexibility of the tire then gives a couple opposing the rotation of the wheel which when compounded with the supporting pressure of the road on the tire, gives the effective center of contact some .2 to .3 inches ahead of the geometrical center, point G, Figure 1.

Again, the axle touches the wheel at a point to the rear of the center as illustrated in Figure 2. The looseness between the wheel and spindle in the figure is exaggerated to show the effect more clearly. The rotation of the wheel carries, as it were, the spindle around with it until a stage is reached when the spindle

slips down continuously on the inclined surface at F. The greater the friction between the spindle and wheel, the farther will F be pulled round from A. The line joining GF gives the direction of the ground reaction. Plainly this inclined reaction has a horizontal effect or component opposing the motion of the car.

The fact that the axle touches the wheel bearing to the rear of the center is not generally known. It may be

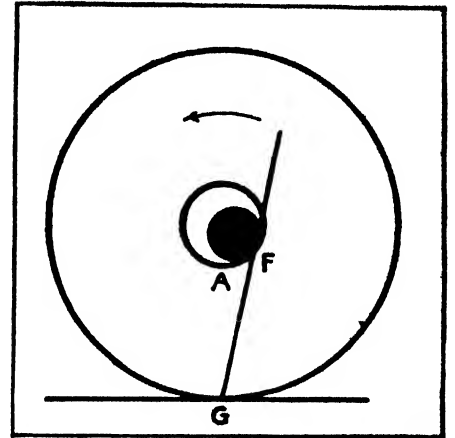


FIGURE 2

The point of contact, F, between the axle and the wheel bearing is to the rear of center

verified readily by experimenting with a six-inch wooden disk which has an inch hole bored out at the center. If a pencil be passed through the hole and pressed downward and forward, causing the disk to roll along a table, the pencil will be found touching the disk to the rear of the center line as indicated in Figure 2. Again if the axle of a farm wagon be examined, it will be found worn remarkably on the underneath to the rear.

For driving tires, the ground exerts a forward force and a forward couple so that the effective center of tire contact is to the rear. Axle and wheel contact are to the rear as in the case of front wheels.

The effect of increasing the size of a wheel is to insure that the ground

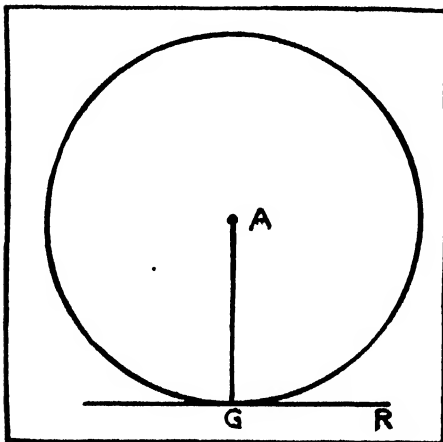


FIGURE 1

The wheel is used to make the ground reaction force at point G vertical to the ground, R

direction in which it is powerless to oppose the motion of the vehicle; that is to say, the wheel brings the ground reaction normal or perpendicular to the road surface. The force of the ground on the car, however great, can then have no component in a horizontal direction, and it is only such forces as have a horizontal component or effect that can offer any resistance to the progress of a vehicle.

Taking say the front wheel of an

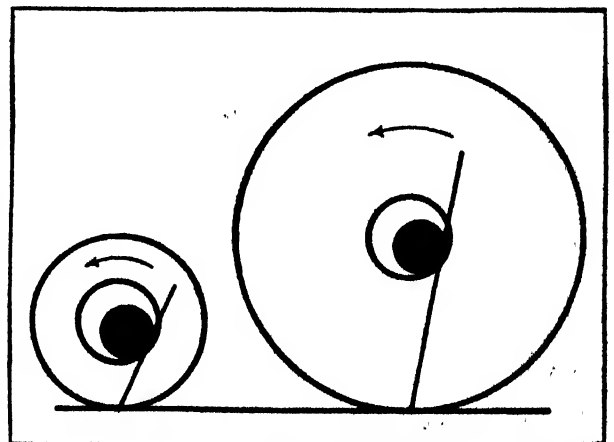


FIGURE 3

In larger wheels, right, the ground reaction is more nearly vertical, and draught is easier than with smaller wheels

The "Why" of Wheels

TO regular readers of the SCIENTIFIC AMERICAN, Mr. Cormac's name is familiar. His articles on engine balance, which appeared in July and August, 1925, aroused much favorable comment, judging from the number of letters which we received. The present series, dealing with idiosyncrasies of wheels, will, we are sure, be received just as favorably.

Many of our readers will agree with the facts put forth by Mr. Cormac, and probably many will disagree with him. The subject is one which affects us all in this era of automobiles, and wheels in general, and much valuable information is to be gained by a thorough study of them. For example, tire wear in automobiles is one of the considerations taken up in the present article.

—The Editor.

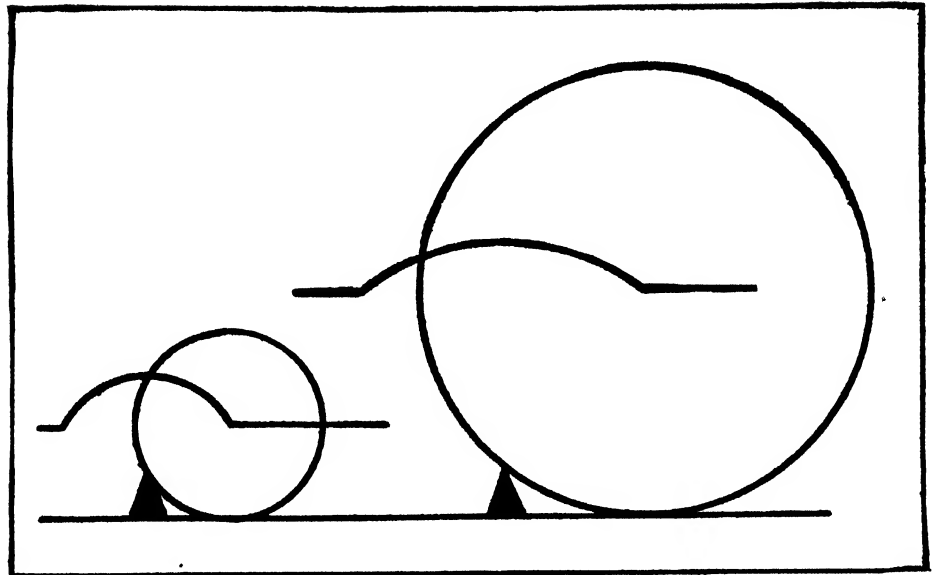


FIGURE 4

In these two drawings, note the curves depicting the paths of the axles. That of the larger wheel is flatter, and therefore, less jar or shock is transmitted to the chassis when riding over a road bump

reaction is more nearly vertical. Two wheels, one double the size of the other, are shown in Figure 3. With the same size axle, it will be seen that the smaller the wheel, the greater is the angle of backward slope of the ground reaction, and in consequence, the greater is the horizontal effect or component opposing motion. Large wheels therefore give much easier draught than do small wheels. It will be evident also from Figure 3, that cutting down the size of the axle will give the ground reaction more nearly vertical, and will therefore tend to reduce tractive effort.

Another advantage of a large wheel is illustrated in Figure 4 which shows the path of the center of a large and a small wheel as they pass over the same obstacle. Although the rise in the

path is the same for both wheels, it forms a flatter curve with the larger wheel, and so gives less jar to the chassis. In addition, the energy lost in surmounting the obstacle is greater with the smaller wheel, and further, the smaller wheel is more likely to lose contact with the road which would occasion a still greater energy loss.

A CURIOUS point in favor of a small wheel is shown in Figure 5. The large and the small wheel are running over a wavy surface. When the radius of the wheel is less than the radius of the trough, the path of the axle is a smooth curve as shown for the smaller wheel. When the wheel radius is equal to, or greater than, the radius of the trough, there is a sudden change in the curvature of the axle path, as when the large wheel takes up contact

with the road at *B* and breaks contact at *A*. The blow on the tire at *B* causes undue wear, and is transmitted as shock to the axle and steering mechanism.

There is considerable variation in the diameter of wheels for road vehicles. The rear wheels of farm wagons are made about five feet high; front wheels are made smaller about four feet—to allow a greater angle of lock of the front axle without the wheels fouling against the sides of the cart. The rims of these wheels are made in sections, called felloes, of ash, oak, elm, or beech. The spokes are made of cleft oak, and the hubs or stocks of well-seasoned elm.

The wheelwright favored the construction of large wheels; the long spokes were more easily sprung into the felloes. The old fashioned ordinary bicycle (Figure 6) had a wheel five feet in diameter.

Automobile wheels are usually between 30 and 36 inches in diameter. Weight, body clearance, tire cost, and gear reduction are features which have influenced this figure. The revolutions per minute of the average automobile wheel is 11 times the speed in miles per hour. The speed of a bicycle is the number of revolutions in five seconds.

WHAT may be called the Second Law of the wheel is its sense of direction. If the speed of a wheel or rim be sufficiently high, it will automatically steer itself in a straight course on a level road. This can be readily verified by rolling a coin along a table or floor. For a coin or disk, the minimum speed for straight rolling is the speed which would be acquired by a body in falling from a height equal to one quarter the radius, while for a rim or hoop, it is the same as the speed of a

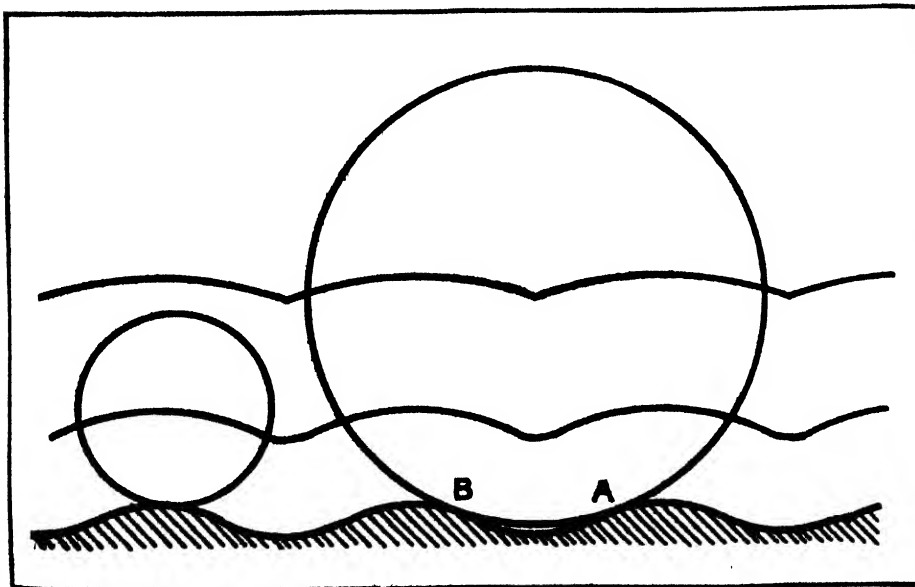


FIGURE 5

When running over a wavy surface, a small wheel follows more closely the surface of the ground, while a large wheel frequently breaks contact. Result—harder riding when on certain surfaces

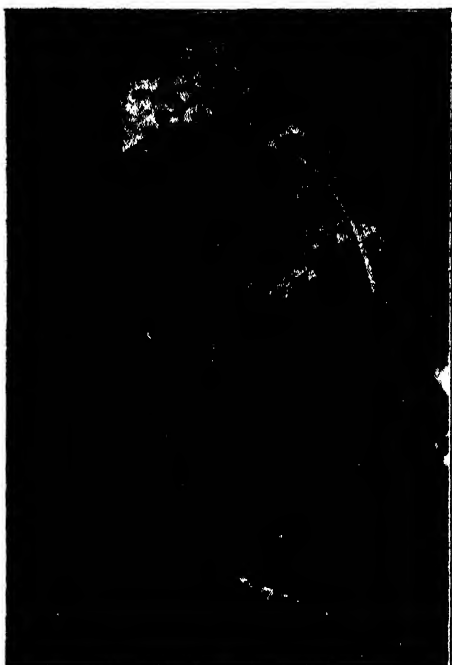


FIGURE 6

Remember this one? The old-fashioned bicycle had a wheel five feet in diameter

body after falling through one third the radius.

A calculation for a 30-inch tire shows that the minimum speed for straight rolling is 4.3 miles per hour, so that it is an easy task to roll a pair of tires if one walks at a brisk pace. At this, or a greater speed, the tire will roll with its plane vertical. When the pace falls below the critical value, the inclination of the rim to the vertical increases while the path becomes curved, the radius of the track decreasing as the inclination of the tire increases.

We have seen that a wheel with its plane vertical will, on a level surface, roll in a straight path. We have now to inquire what is the path of a wheel when its plane is tilted out of the vertical. As with the vertical wheel, the rim being tangent to the ground will touch it at two consecutive points. As the rolling proceeds, the contact point to the rear rises as simultaneously a contact point in front falls on the ground. *These points rise and fall vertically.* Were they to rise obliquely, it would mean that one or other of the pair of consecutive points of contact would slide over the ground. We therefore arrive at the result that the wheel track is the plan of three consecutive points on the wheel rim at the point of tangency.

SINCE the plan of the wheel and the wheel track have three consecutive points in common, the track is the circle of curvature of the wheel plan at the point of tangency. In examining the rolling of a right circular cone on the ground, we arrive at the same result for the track of the disk forming the base of the cone. From the cone analogy, or from the known fact that

the center of curvature of a wheel plan at its point of contact is at the intersection of the wheel axle and the ground, we deduce the important practical result that a wheel in rolling pursues a track which is a circle about the point where the axle produced cuts the ground.

Several examples can be given of the application of this principle to steering. The boy with his wheel (Figure 7) watches it steer to the right as its plane leans over in that direction. When a wheelbarrow is to be taken around a curve, the outside handle is raised and the inside handle dropped so that the wheel of the barrow (Figure 8) is inclined towards the center of the curve.

The sociable monocycle, (Figure 9) relies entirely on this principle for its steering. Desiring to turn to the right, the cyclists incline the machine over in that direction, straightening out being



FIGURE 7

A wheel rolling and inclined as shown, tends to steer in the direction in which it leans

accomplished by adjusting the wheel to the vertical position. The changes in the inclination of the wheel are brought about by one or both cyclists leaning over to alter the position of their common center of gravity with respect to the machine.

It may be remarked that to run this cycle straight along the edge of a cambered road, its plane would have to be maintained inclined so as to be perpendicular to the road surface. The same remark applies to a wheelbarrow run across a sideslope. If the wheel be maintained plumb, the barrow tends to run uphill. If an elliptical wheel be fitted, it is interesting to observe the wobble on a curved track due to the varying curvature of the wheel plan at contact.

We have shown that a wheel rolls naturally in a track which is the circle of curvature of the wheel plan at the point of road contact. The track and

wheel plan, in this case, have three consecutive points in common, or contact of the second order. The wheel, however, can travel without sideslip if it pursues a track which has but two consecutive points in common with the wheel plan. This means that the wheel plan and the wheel track still touch each other, but with contact of the first order only. This condition is satisfied when the wheel runs in a circle which has its center at any point on the plane of the wheel axis. When, therefore, a wheel cannot pursue its natural rolling path, it will endeavor to turn about some other point on the production of the axle.

ALTHOUGH there is no sideslip of the tire over the ground when the track and wheel plan have contact of the first order, the action is not pure rolling but a combined rolling and spinning. The spinning involves the sliding of one of the consecutive points of contact over the ground while the other point maintains contact. A case of pure spinning is exemplified by a coin twirling like a spinning top on a table.

As an example of wheels prevented from pursuing their natural rolling path, we may take the front wheels of an automobile. These wheels are inclined outwards as shown in Figure 10. The cant or camber varies from two to six degrees, or what is the same thing, the tops of the wheels are from two to six inches farther apart than the bottoms. The natural rolling path for the left-hand wheel is the circle which has its center at V, the point where the stub axle produced cuts the ground. The wheel may correctly be regarded as the base of a cone having its apex at V. Plainly the left wheel



FIGURE 8

A wheelbarrow is steered by raising one and lowering the other handle, inclining the wheel

tends to roll to the left, and the right wheel to the right. This, being impossible on a straight course, involves spinning of the tire on the ground.

TWO degrees of camber give a spinning rate which is $3\frac{1}{4}$ percent of the revolution rate. At 40 miles per hour, corresponding to 440 revolutions per minute of the road wheels, the spinning action is at the rate of 15 revolutions per minute. If it be considered that this is equivalent to turning the steering wheel from full lock on one side to full lock on the other side at about 90 times a minute,

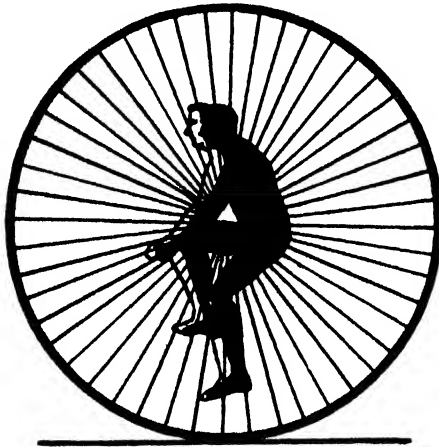


FIGURE 9

In the sociable monocycle mentioned in the text, there are two riders placed side by side

the wear of tires and loss of power entailed will be realized.

If the road be cambered so that the surface becomes normal to the wheels, the spin action is eliminated. It is of importance, therefore, that the camber of front automobile wheels be coordinated to the average camber of the concrete road. A road 24 feet wide, finished to a circular arc giving a $4\frac{1}{2}$ -inch rise in the center, would take a two-degree setting of front wheels to bring them normal to the cross-section of the road surface.

Nothing can be done to eliminate the

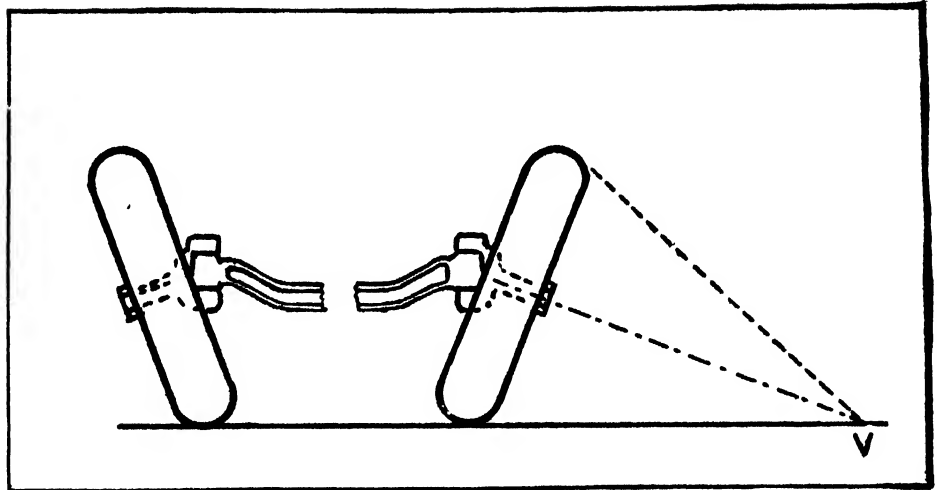


FIGURE 10

The front wheels of an automobile are cambered from two to six degrees, exaggerated above. This camber is necessary in order to insure complete stability when on a straight course

spinning action of rear wheels on such cambered roads, for the rear tires, being vertical, must spin unless the cross-section of the road be straight.

Front tires, having no driving torque to transmit, should wear much longer than rear tires. The spinning action noted accounts in part for the fact that they wear as quickly, if not more quickly, than rear tires. This is more pronounced with balloon tires on account of the greater contact area. Want of alignment of balloon tires is a serious cause of wear. A front tire is under tension at the portion which impacts on the road, whereas a driving tire is under compression at this point. This may account for the more damaging effect of the roadway on front tires.

The wheels of horse-drawn vehicles are given a camber of about 15 degrees. This applies to both front and rear wheels. The reason for this camber arises from the dishing of the wooden wheels of farm carts, wagons, and carriages. The spokes, in radiating out from the hub or stock, also come forward away from the cart, giving the wheel a saucer or dish

shape. This construction enables the wheel to resist large side-forces without becoming distorted.

Wheel loads due to sidesway of the cart are taken up as a compression in the spokes of one or other of a pair of the wheels. With a flat or undished wheel, side forces put the spokes in tension, thus pulling them out of their sockets. So that a dished wheel may "torque on every spoke," that is, have the spoke vertical as it comes directly under the axle, the wheel must be given a camber setting corresponding to the angle of dish.

The spin action, introduced by the camber setting of wheels, tends to give stability to the straight course of the vehicle. A deflection of the vehicle to the left diminishes the rate of spin of the left wheel and increases that of the right wheel. The twisting effect (in the steering sense) on the wheels, due to the excess spin of the right wheel over the left, tends to pull them back to the straight course. We may instance here the effect of the coring of locomotive tires in preventing "nos-ing" of the engine.

Locomotive tires are turned to a template sloped 1 in 20, (Figure 11). As the rail is sloped to correspond to the core of the tire, the effect is the same as a camber of three degrees given to automobile wheels. The 1 in 20 slope of the tire gives a spin between the tire and the rail at the rate of one complete spin for 20 revolutions of the wheel. As with the automobile, the spin tends to keep the locomotive on a straight course, since deviation one way or the other gives a resultant spin tending to restore the axles to the straight and therefore tending to hold the locomotive steady.

In our December issue, we will present the second article of this series on wheels. We can assure our readers that it will be as interesting as the present one, and will be well worth waiting for.

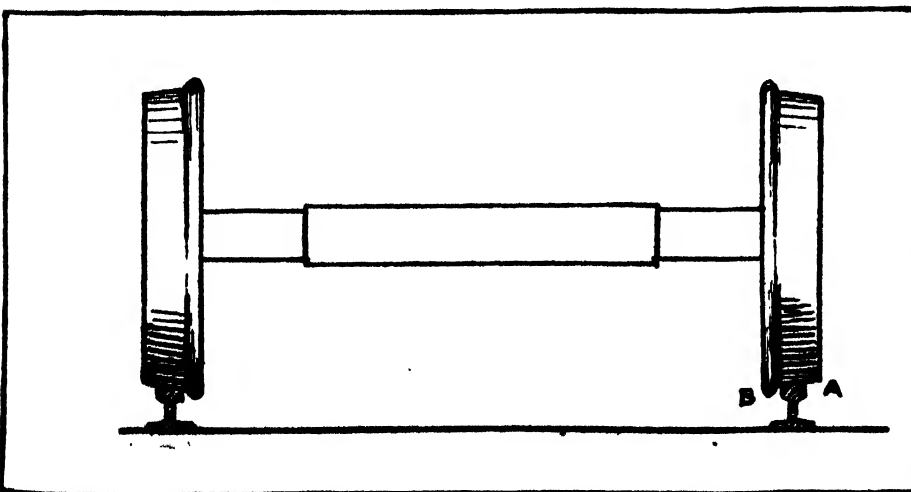


FIGURE 11

The tires on locomotive wheels are turned with a down slope from A to B. This has the same effect as the camber of the front wheels of the automobile, as shown in figure 10 at right above

Asteroid Hunting

Astronomers Now Conduct the Search for Asteroids or "Pocket Planets" by Modern Mass-Production Methods. Is There an Undiscovered Planet Beyond Neptune?

By HENRY NORRIS RUSSELL, Ph.D.

*Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington*

IF the average man should be asked whether the discovery of a new planet would count as an important item of news he would probably reply in the affirmative; and, interpreting the word "planet" as he probably would to mean a body comparable in size with the Earth on which we live, he would be entirely right. Only two planets of this sort—Uranus and Neptune—have been discovered since history began to be written, and in both cases the discovery aroused the widest and liveliest interest.

But if a planet is defined as astronomers are wont to do, merely as a body pursuing an independent orbit about the Sun, the discovery of one more or of a dozen is hardly news at all. The daily press is likely to pass it over entirely, and even in the technical literature of astronomy the announcement will occupy little space and create no excitement.

THE reason is, of course, that small planets—or as they are commonly called, "asteroids"—are so abundant that the discovery of a few more is of interest only to a few specialists.

More than a thousand of these little bodies are already listed in the latest of the annual supplements to the German Nautical Almanac, which by international agreement publishes the latest data on the subject. The best list is increasing by 20 planets or so a year, and it is probable that another thousand or more will yet be added before the tale comes to an end.

With such numbers to deal with, astronomers suffer from an embarrassment of riches, and it is clear that something like the methods of "quantity production" must have been applied in this field of science, in order to give us as much knowledge as we have. This is indeed the case, especially in the matter of discovery. One can fairly promise a graduate student of astronomy that if he can secure the privilege of observing with a suitable

instrument he will be able to discover at least half a dozen planets, and probably many more, in a year's work.

No one can tell an asteroid from a star, merely by looking at it. Except for three or four of the very brightest which have been known for more than a century, they appear only as faint, luminous points without perceptible diameter. They can be picked out only by their motion. In the old days, until about 25 years ago, it was a very hard job to find the one moving asteroid among a thousand fixed stars.

or later patience was rewarded by the discovery of some object which shifted its place from night to night, and a new planet was added to the list. The fact that more than 200 asteroids were discovered in this exceedingly laborious fashion bears eloquent testimony to the assiduity of the earlier observers.

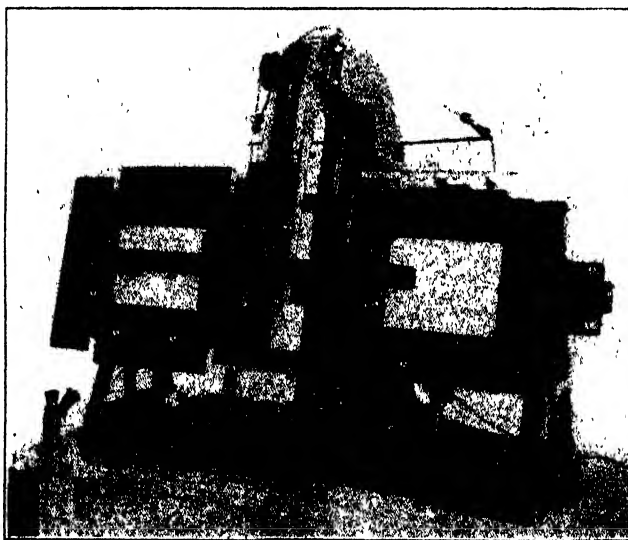
But photography opens the royal road to discovery of this sort. The modern observer provides himself with a camera of large aperture of lens and wide angle of field, or preferably with a pair of such instruments on the same mounting. Picking out any suitable region of the sky, he puts in a pair of plates and exposes for two or three hours, guiding carefully meanwhile so that the star images on his negatives are sharp round dots. The motion of an asteroid during two hours is rapid enough to draw out its image into a quite perceptible trail or streak which can be picked out at once among the thousands of stars. The duplicate plate guards against any danger of being deceived by some trail-like marking due to a defect on the plate.

BY this method—invented by Professor Max Wolf of Heidelberg—asteroids may be discovered literally by wholesale. Those which have previously been known are of course picked up with the others, so that the work of the earlier visual observers is repeated with but a small fraction of the labor.

Good as this method is, it has one disadvantage. The light of the stars which are not of intense interest in this connection is concentrated into

point-images, while that of the asteroid is drawn out into a trail and enfeebled. If we knew just in what direction the asteroid was moving and at what rate, it would be easy enough to adjust our guiding so as to follow the planet and concentrate its light into a sharp image, while the unwanted stars were drawn out into trails.

Of course, we cannot say exactly



Courtesy of Carl Zeiss, Inc.

THE STEREOCOMPARATOR, WITH BLINK MICROSCOPE

Finding the needle in the celestial haystack is quick work with the ingenious blink microscope. It is used for ascertaining slight differences between two otherwise identical photographic plates. The two plates are mounted in the apparatus and viewed alternately from a single eyepiece (through a series of reflecting surfaces) by an oscillating device which shifts the view from one plate to the other in rapid succession. If the two plates, each of which may show thousands of stars, are wholly identical, they will look like a single plate; but if there is any slight difference, such as a new star or an asteroid in a new position, that object will be revealed instantly as a dancing spot; that is, it will "blink." The former method of comparison was simply by "main strength and awkwardness;" the worker examined the two plates systematically, minutely—and endlessly!

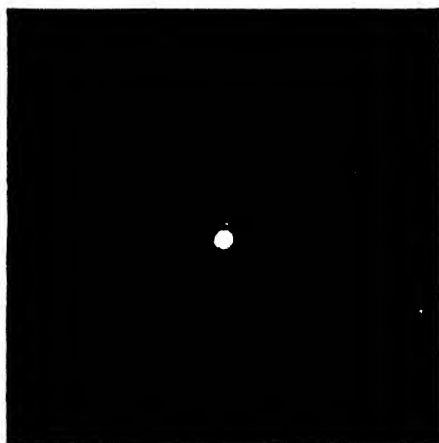
The observer had to prepare an accurate chart of some selected part of the heavens, showing all the stars visible with his telescope, and then to search this region over and over again, looking for some faint star which did not appear on the chart. If one was found it often turned out to be a variable star which had increased in brightness since the chart was made; but sooner

what the motion of an undiscovered asteroid will be, but we can at least adjust our apparatus to follow the motion of an average asteroid. Individual small planets whose motions differ from the average will then show on our plates as short trails, while the stars appear as longer ones. This method, which greatly increased the effective power of the camera, was invented by an American amateur astronomer, Reverend J. H. Metcalfe, whose death a few years ago was a great loss to this branch of the science.

With "scientific management" thus applied to the problem, the discovery of asteroids is almost too easy. Indeed, they have been found faster than they can be looked after.

THE discovery of any heavenly body, of course, is only the beginning of a long course of activity. In the case of a planet we need to know its orbit so that we can calculate in advance where to look for it in future years. To calculate this orbit is our next problem.

When the first asteroid, Ceres, was discovered in 1801, this problem was altogether new—and it is by no means easy. The great mathematician Gauss solved it within a few months, so that the planet was found the next year close to the calculated position. Later investigators have improved the practical details of the calculations without adding much to the general principles on which they are based.



Yerkes Observatory
URANUS AND TWO SATELLITES
Photographed by Hubble, at Yerkes. It was by the gravitational pull (perturbations) on Uranus that Neptune was first discovered

Three good observations of the planet's place in the sky suffice under ordinary circumstances for a solution of the problem (occasionally a fourth observation may be necessary). From accurate observations ten days or so apart a good determination of the size, shape, and position of the orbit can be made, but things do not always work out so nicely.

In the first place, faint asteroids can not be photographed in full moonlight, which fogs the plates. If the Moon

comes along at the wrong time, only one or two observations may have been secured, and after the Moon is out of the way it may not be easy to find where the faint, moving speck has gone. Many asteroids are thus lost immediately after discovery and before there is any chance of getting an orbit. The whole number of these runs far into the hundreds.

Again, if these observations have been secured, one of them may be wrong by some small amount. The mathematical formulae lead to an orbit which agrees perfectly with the observations on which it is based; but if these observations are wrong, the calculated orbit will be wrong too—and the error may be greatly magnified. In particular, the period of the planet may come out a little wrong. The effect of such an error is cumulative with the lapse of time, and after a few years the calculated position may be hopelessly far from the real planet. In this way, too, a good many asteroids have been lost.

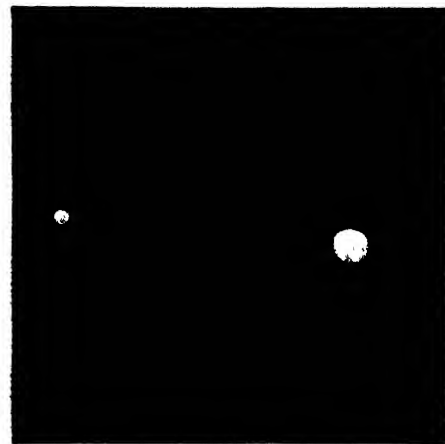
SUCH losses are, however, only temporary. As the work of systematic discovery continues, the lost planets sooner or later will be picked up again, unexpectedly. If on the second occasion a good orbit has been determined, calculations of the position of the asteroids in past time will show whether it is identical with any of the lost planets of earlier years. Several long-lost planets have been recovered in this way, some after 30 years or more.

When a good orbit has been obtained from observations in one season, the position of the planet at the next opposition rather more than a year later can be predicted. A search for it is then easy and it is likely to be found, except in a few cases where it is much farther from the Earth than before, and hence very faint. It is rarely if ever found exactly in the computed position, but from the discrepancy it is possible to calculate more accurate values of the elements of the orbit which represent the observations of both years.

When the process has been carried on for a couple of more oppositions a reliable orbit can be obtained and the elementary part of the problem is solved so far as this planet is concerned. More and harder work has still to be done, for no account has yet been taken of the complications, due to the fact that the planets as well as the Sun are attracting the asteroid. But the story must wait until next month.

Meanwhile a word may be said upon the question of the possible existence of another large planet besides those at present known. Photographs taken during total solar eclipses have shown that there can be no planet bigger than a smallish asteroid inside the

orbit of Mercury. Is there a planet beyond Neptune? Many attempts have been made to find such a body from the perturbation of Neptune and of Uranus, as Neptune itself was found by means of the perturbations of Uranus. The general outcome of these investigations indicates that an outer planet, if it exists, must be rather small



Yerkes Observatory

NEPTUNE AND SATELLITE

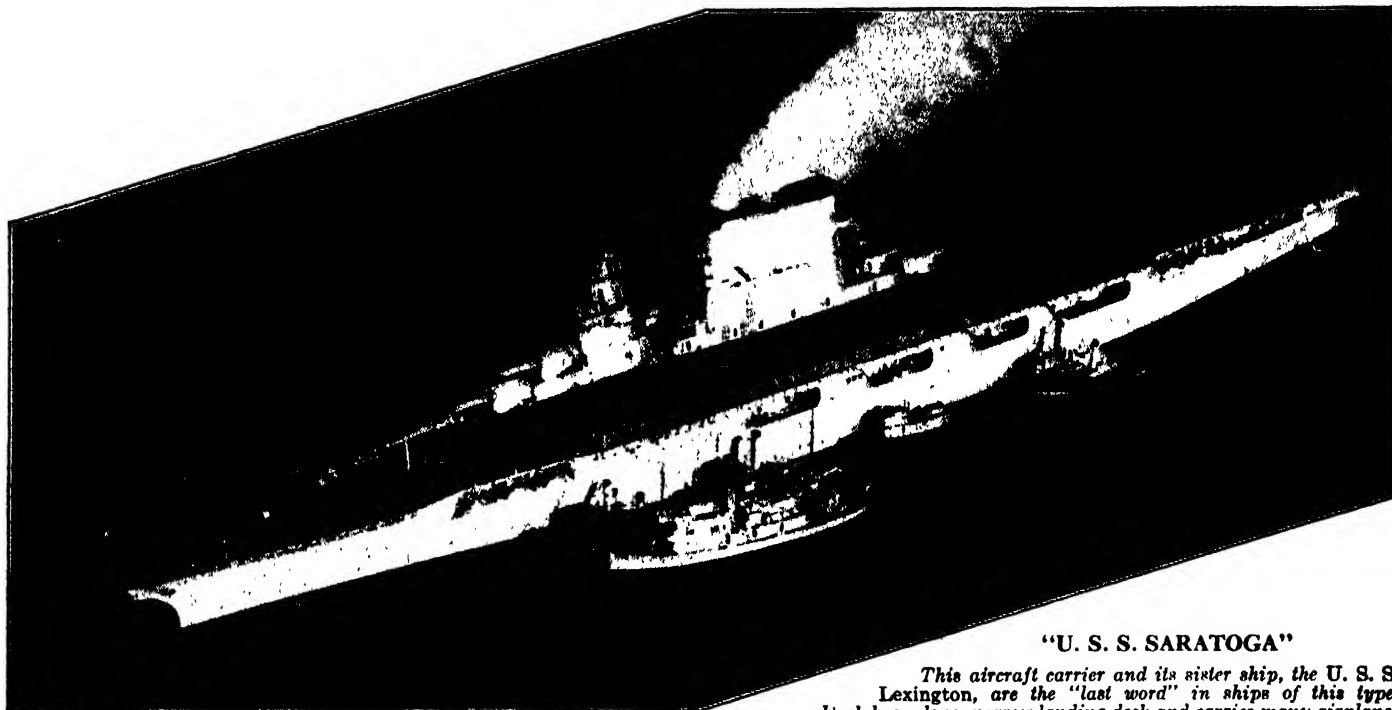
Photographed at Yerkes. Neptune was discovered in 1846 as a result of a deduction by Leverrier who noted its perturbations

—probably considerably smaller than Neptune and too small for its attraction to produce sensible disturbances of the inner planets.

SUCH a planet, nevertheless, might easily be within the range of brightness accessible to modern photographs with instruments of moderate power. A search for it by the photographic method would be well repaid. The routine of the asteroid hunters would require small modifications, for the planet's apparent motion would be slower and its trail on a two-hour exposure very short. By taking plates on consecutive nights, and comparing them with the blink microscope, the planet's motion would become conspicuous and could be picked out at a glance.

The campaign would demand the taking of perhaps a hundred plates in duplicate, extending step by step all around the ecliptic; and the examination of millions of star images. Whether a trans-Neptunian planet would be found depends on whether one is there to find; but the knowledge that there was no such planet brighter than a given limit of stellar magnitude would be worth the labor of an unsuccessful search. Moreover, the by-products in the discovery of asteroids, variable stars and the like would give the observer plenty to do—perhaps more than he had time for.

Analysis of metals by means of their spectra is a method which promises to grow in popularity because of its efficiency. A description of this work will appear in a future issue.



"U. S. S. SARATOGA"

This aircraft carrier and its sister ship, the U. S. S. Lexington, are the "last word" in ships of this type. Each has a long, narrow landing deck and carries many airplanes

Courtesy General Electric Company

Naval Adequacy—III

Comparison of Naval Strength in Ships, of Great Britain, Japan, and the United States, Shows the Weakness of Our Fleet

By CAPTAIN N. H. GOSS, U. S. N.

WE have seen how naval strength depends inherently upon naval bases and how the strength of a fleet depends upon types. We shall now consider how naval strength further depends upon relative numbers of these types and how the various classes within these types differ in comparative value.

The diagram on the opposite page shows graphically the comparative numbers and tonnage of the principal types of fighting ships owned by Great Britain, the United States, and Japan. Of these ships, as everyone knows, only capital ships and aircraft carriers are limited, having been standardized at the Washington Conference. Comparative fighting strength of these fleets, however, depends upon a great deal more than actual tonnage and numbers, as we shall see.

The British and Japanese fleets each include four battle cruisers among their capital ships. The World War and strategic game board studies have shown the value of ships of this type. They can act as a protective screen strong enough to drive off enemy cruisers that are seeking information, or as an offensive screen fast enough and strong enough to seek information

in comparative safety far ahead of the fleet. They are valuable for raiding enemy communications, and destroying and scattering the enemy's slow convoys; or to act as an advanced wing with the battle fleet, fast enough to reach decisive points quickly, and strong enough in gun-power to fight at extreme ranges. Their heavy guns enable them to out-class any cruisers while their speed enables them to keep away from enemy battle-ships, and greatly facilitates avoidance of submarine attack.

JAPAN'S four battle cruisers are particularly valuable to her, operating as they do from her secure network of bases and, in the event of war with us, against the exposed line of communications we would have to maintain in any movement to cover our possessions in the western Pacific. They are stronger than any combination of cruisers that could be brought against them, and could out-run and out-maneuver our battle-ships with impunity. They are actually more valuable to Japan than would be their equivalent ratio in battle-ships, since their strategy could prevent their battle fleet from locking arms in a broad-side encounter with our battle-ships.

The Singapore base, Hong Kong, and the network of harbors in and about the Caribbean, available to the British for shelter and fuel, would permit their battle cruisers much freedom of action; and it must be remembered that superior speed permits its possessor to choose his own time and terms.

It has long been the policy of our navy to give our battle-ships the maximum in gun-power, armor, and protection even at the expense of speed. This seems sound because, situated as we are without numerous bases, our capital ships must be able to withstand heavy punishment on the high seas; but, as before indicated, even battle-ships differ among themselves, the latest to be built being naturally the best.

Our custom before the World War of laying down two battle-ships a year resulted in a battle-ship force that is not homogeneous. For example, six of our battleships have 12-inch guns. These are considerably less powerful than the guns mounted in the capital ships of the other two nations under consideration.

None of these British ships mount guns of less than 13.5-inch bore—the practical equivalent of our 14-inch—while 10 British battle-ships and three

of their battle cruisers mount 15-inch, and their two new battle-ships carry guns of 16-inch caliber.

Two Japanese battle-ships mount 16-inch guns and Japan's remaining battle-ships and battle cruisers carry 14-inch guns. Our three latest battle-ships carry 16-inch guns and the remaining nine mount 14-inch. These guns actually differ considerably in striking power. While 14-inch and 13.5-inch guns may be considered adequate, a 12-inch shell is too light to be effective at modern battle ranges.

All the foreign capital ships, with the exception of the four British "Iron Dukes," are faster than ours. The battle cruisers naturally are much faster by from six and one-half to 10 knots. The five British "Queen Elizabeths" are four knots faster, while the speed of their two new "Nelsons," their five "Royal Sovereigns," the two Japanese 16-inch gunned "Nagatos," and the two Japanese "Ises," is 23 knots. The two remaining Japanese "Fusos" have a speed of not less than 22 knots. So all of the foreign capital ships, except the four oldest British ones, are superior to ours in speed, some of them markedly so.

NOT only do the British have two more capital ships than we, but one of these is the giant *Hood*, the greatest war vessel ever built. It is more than 7000 tons greater than any we will be permitted to build in the future, its size being sufficient to combine the adequate under-water protection and gun-power of a battle-ship with the speed of a light cruiser.

The Japanese with their compact, high-speed capital ships, operating from numerous bases, have an advantage in the region about our possessions in the Far East that our greater tonnage in slow capital ships does not neutralize. We now begin to see how inferiority of classes or lack of an essential type, handicaps a fleet and weakens actual naval strength.

No power has yet built up to the limit of the tonnage prescribed for the comparatively new aircraft carrier type. The great size of the largest yet built—the two of the "Saratoga" class built by this country and the *Akagi* and *Kaga* by the Japanese—is due to conversion of vessels already laid down at the time of the Washington Conference. While ships of this extreme size, capable of battle cruiser

speed, undoubtedly have great tactical advantages in that they could quickly deliver a great number of airplanes at a decisive point, all plane carriers are so vulnerable above water that it is doubtful whether any country would again place so many eggs of the authorized tonnage in one basket.

Most of the British carriers are also converted vessels, the *Eagle* being built upon the hull of a battle-ship, and the *Furious*, *Courageous*, and *Glorious* from the three large "hush-hush" cruisers built by Lord Fisher during the war.

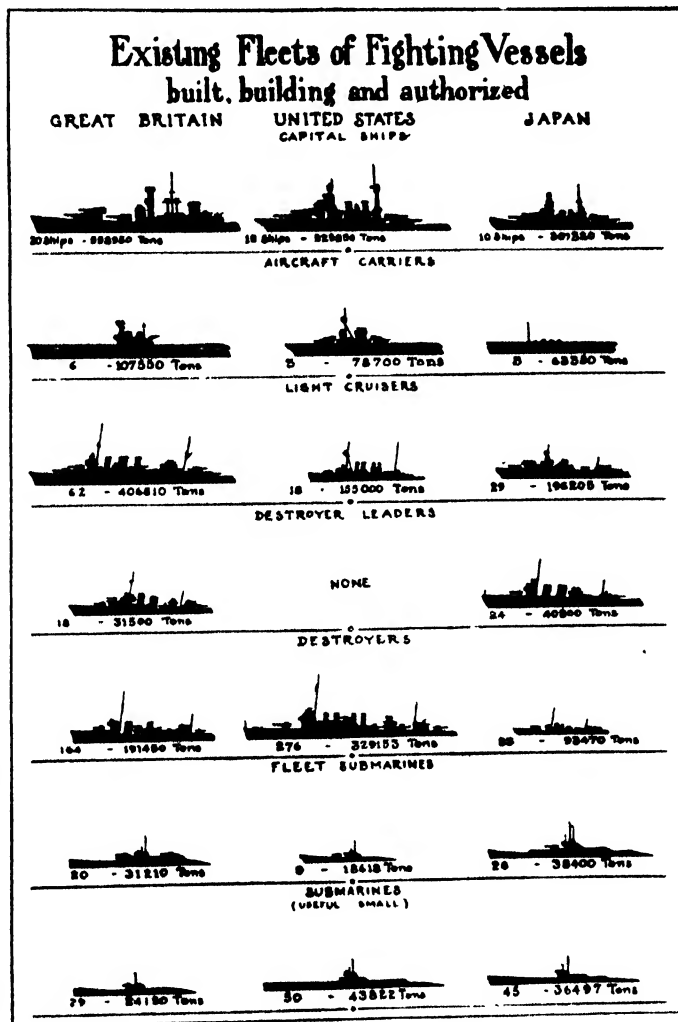
hull, so that the Japanese strength in this type is comparatively high. Of the lot, the three British of the "Furious" class are, doubtless, the most vulnerable under water, but their high speed should considerably safeguard them from submarines.

The light cruiser is probably the most widely discussed type at present, as it is a most important vessel. As is now generally known, the Washington Conference established a size limit in tonnage and guns for this type, but did not fix any limit to effective age or numbers. The diagram tells the story very graphically in this case. Both the British and Japanese have been not only convinced of the value of this type, but have been quick to build as well the new class established by the Washington Treaties. As it stands now, they each have an overwhelming superiority in this type.

This modern cruiser is quite a different vessel from its predecessor, the slow, coal-burning, armored or protected cruiser that obtained previous to 1910.

THESE later vessels are oil burning, of considerable gun-power, excellent sea keeping qualities, all of considerable cruising radius, and have comparatively better water-tight sub-division than their predecessors. In fact, during the war they successfully withstood an almost incredible amount of punishment. The British, as a result of their experience during the war, developed classes of these vessels to work with the battle fleet and adapted to base upon their numerous harbors; and the Japanese quickly followed suit. Each of these nations now has a numerous force of these vessels, all modern and all comparatively new. In addition, each has proceeded

to lay down an extensive program of the new 10,000-ton class, often referred to as the treaty cruiser. Of these, the most powerful class permitted, the British have authorized 16, of which seven of the "Kent" class, four of the "London" class, and three of the "Norfolk" class have already been laid down. They have also authorized seven of the "York" class of 8000 tons—of which one has already been laid down—a somewhat smaller cruiser well adapted to their use by virtue of their extensive bases. This latter class as well as all the other large ones, carries 8-inch guns, the largest caliber permitted by the Washington Treaties.



NAVAL STRENGTH GRAPHICALLY SHOWN

The sizes of the silhouettes indicate the relative strength of the three navies under discussion here. Note that we have no destroyer leaders

Only one, the *Hermes*, represents an original design from the keel up.

While the plane carrier is undoubtedly still in process of evolution, its value has already been demonstrated and the comparative strength of these vessels with their accompanying planes is not far different from the ratio of actual tonnage. The greater number of British carriers, three of which are also of battle-cruiser speed, probably offsets the larger size of our two new ones. It is to be noted also that the *Kaga*, converted from a battle-ship hull, is also credited with a speed in excess of 25 knots, and that the *Akagi* is built upon a battle-cruiser

So, out of a total of 62 of these modern cruisers authorized, the British have no less than 53 already built or actually laid down. When we consider how the British network of bases and fueling stations throughout their strategic areas and along their lines of communication augment the relative strength of vessels by what amounts to an increase of numbers, it is easy to see what a very powerful cruiser force the British have at the present time.

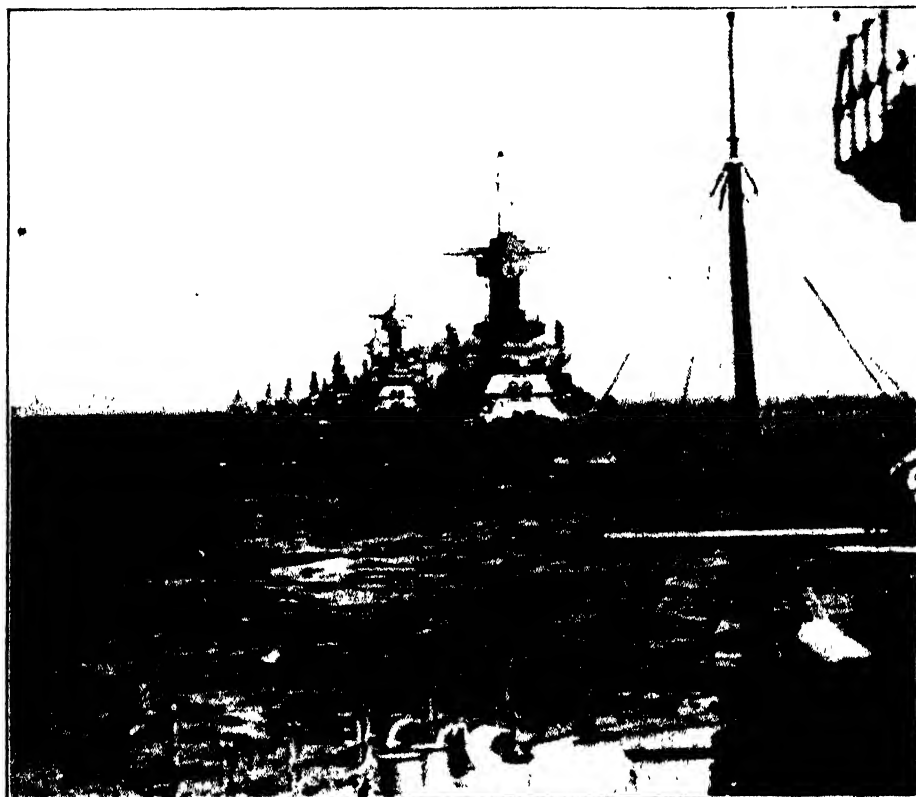
sea for the long periods and at the great distances necessary.

At the close of the World War, each of the principal naval powers had a considerable force of older cruisers. Most of these, however, were quite obsolete and very vulnerable to all forms of attack as shown by the three "Cresseys" sunk by one submarine, by the *Warrior* and *Defense* which were quickly sunk by gun-fire at Jutland, and by our own *San Diego* which was

slow to be classed as a modern light cruiser. Here, again, the numerous British bases give some value to these nine vessels.

From the diagram we note that we have no destroyer leaders. To anyone who has attempted to handle destroyers with the fleet during maneuvers or on the game board, the magnitude of this handicap is quickly manifest. We are unable fully to utilize the great potential value of our destroyer force, the one type in which we exceed in present strength of vessels. Of leaders, the British have 18, presumably the number their experience indicated they needed. The Japanese have also gone in extensively for this type, of which they now have 24 large enough to be classed as leaders.

As the result of our war-time effort to overcome the submarine menace, we have a very large force of destroyers—all valuable vessels although more than half of them are greatly handicapped in steaming radius due to the type of machinery it was necessary to use during the rush of war-time construction. The British have 164 of their sturdy destroyers and the Japanese already have 83, mostly of post-war construction. Each power has a number of the older, smaller torpedo boats not included in the above considered tabulations. We have 33 of 28,515 tons; the British have six of 4200 tons; and the Japanese have 12 of 7850 tons. As these complicated, delicate vessels grow obsolete rather quickly, these older ones are considered of little, if any, military value.



THE BACK-BONE OF THE FLEET

United States battle-ships passing the Golden Gate and entering San Francisco Harbor. In the right center foreground may be seen the wings of one of the airplanes carried by these ships

The Japanese cruiser strength, listed in the diagram, is likewise all modern and includes six of the maximum treaty class, four of this "Nachi" class having been laid down. We have already seen how the Japanese interior lines, resting on numerous bases in the Far East, strengthen their position there for which even their smaller cruisers, especially when so comparatively numerous, are well adapted.

OUR own story of modern cruisers is quickly told. We have the 10 7500-ton ships of the "Omaha" class, mounting 6-inch guns, that were under construction at the time of the Washington Conference, and eight of the 10,000-ton class subsequently authorized, on only two of which—the *Pensacola* and the *Salt Lake City*—has any substantial progress been made. Here it may be noted that the only way we can overcome our lack of suitable bases is by building cruisers of this larger class which alone can have the cruising radius and habitability to remain at

sunk by one mine. In fact, they were veritable death-traps and, by reason of their slow speed and short cruising radius, were of little or no military value. The British were quick to realize this and scrapped 33 of them. The Japanese and ourselves have, so far, retained them. We have actually 22 totalling 179,425 tons, dating from Sampson's flagship, the former armored cruiser *New York*—renamed the *Rochester*—which was laid down in 1890, to the *Missoula* dating from 1905. The Japanese also have a number of these old cruisers—15, in fact—of 98,176 tons. Of these, the three "Chikumas" laid down in 1910, have some considerable value for operating on their interior lines.

In addition, however, to the obsolete cruisers scrapped by the British, they also retained a number of their earlier light cruisers—nine, in fact—of 48,380 tons, the oldest being the three "Dartmouths" dating from 1910 and including, as well, the *Adelaide* which was laid down in 1917 but which is too

SUBMARINES are of two general types, as indicated by the diagram and in the previous discussion. Of these, only the larger type is really habitable for any considerable time at sea. Included in our total are three of the "T" class, designed before the war and already practically obsolete since they do not embody the valuable lessons taught by experience during the great war. Our six new ones of the "V" class are the beginning of a force of these valuable vessels. All of the British vessels of this larger type were constructed during or since the war and most of them are valuable vessels. All of the Japanese fleet submarines are of post-war construction and Japan is considered to have by far the most effective and up-to-date submarine force of this type, a force not limited in cruising radius to the defensive area around their home islands.

Of smaller submarines, the 50 of ours listed comprise the "S" class, the only ones large enough to operate away from a shore base. All of these were designed during the war and are not considered comparable, in efficiency, with the post-war-designed Japanese boats or with the British submarines of later classes. However, they have

considerable military value. This is one class in which we have appreciable strength but here, again, our weakness in bases is a tremendous handicap, while the well-disposed bases of the British enable them to utilize even their smaller submarines to good advantage. This is true also to an even greater extent for the Japanese.

Of the older and smaller submarines not listed in the diagram, our 27 "R" boats have some value for operating from shore bases, but this value is limited. Our oldest classes are not considered to have any value. Great Britain has 23 of these older submarines of equal, or greater, value than ours since they are of later design; and Japan has 10, also mostly obsolete. The Japanese are actually superior in combined submarine strength as practically all their boats are of recent construction.

Aircraft are built so quickly nowadays and their design changes so rapidly, that it is difficult to make any accurate comparisons. Each country, however, has home bases in which to develop the art and train its personnel. The Japanese home bases—particularly the one at Kagoshima in southern Kiushu—are close enough to link up by air alone with many of the outlying Japanese actual, or potential, naval bases. The plane carriers of the different powers carry planes in numbers generally proportionate to their size, although greater numbers of smaller carriers carry comparatively more planes. This is offset somewhat in our case, perhaps, by the superior speed and tactical characteristics of our giant carriers which can quickly bring a great force of combat planes to a decisive position.

IN addition, our battle-ships and cruisers carry their own spotting and observation planes. The ships we have are better fitted in this respect than those of the British and better, probably, than the Japanese ships. Of the three navies, our own has probably devoted the most attention to a rational and systematic development and use of aircraft for naval activities. Much effort has been made in our service to develop aircraft as an arm of the navy; consequently our naval aircraft are well adapted for naval purposes.

Our five-year aircraft program is well under way and planes have been ordered for our authorized cruisers; also, a beginning has been made on planes for the naval reserve. There is little doubt that we are superior to other navies in this modern fighting arm, in efficiency as well as in numbers, since naval aviation, being part and parcel of the navy, has been specifically developed to fit naval needs.

Were there no men-of-war, sea-power would automatically pass into

the hands of the power possessing the greatest merchant marine. All vessels of any appreciable size, say of 2000 tons or over, may readily mount guns; sizeable vessels, say of 4000 and 5000 tons and above, readily mounting five-inch and six-inch guns. Some idea of the strength ratio on this basis may be gleaned from the following tables showing number and tonnage of ships owned:

20 KNOTS AND OVER

	Ships	Tons
Great Britain	12	351,041
Japan	2	10,524
United States	2	58,312

18 KNOTS AND OVER

	Ships	Tons
Great Britain	38	767,201
Japan	2	10,524
United States	6	134,538

16 KNOTS AND OVER

	Ships	Tons
Great Britain	145	2,109,729
Japan	10	93,589
United States	37	452,874

14 KNOTS AND OVER

	Ships	Tons
Great Britain	435	4,569,367
Japan	56	416,501
United States	101	940,512

period—1921 to 1926:

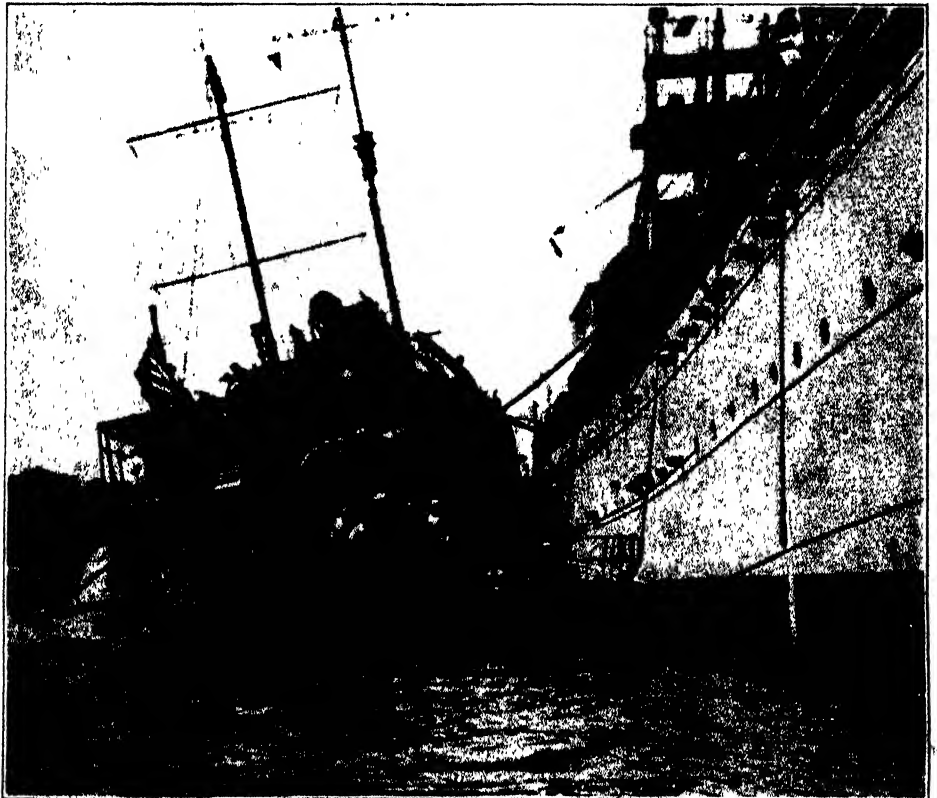
	Ships	Tons
Great Britain	600	3,500,000
Japan	52	250,000
United States	14	137,000

At the present time, there are actually under construction the following:

	Ships	Tons
Great Britain	142	908,000
Japan	19	100,000
United States	4	63,000

The above graphically illustrates the overwhelming superiority of the British and the great margin the Japanese have in the Far East in merchant vessels, all of which have an inherent bearing on naval strength.

ALTHOUGH the Washington Conference standardized only capital ships, and aircraft carriers, and limited only the maximum size of individual cruisers, the 5-5-3 ratio quickly became an established principle in the minds of our people. As intimated heretofore in this series, however, the Conference did fix one other limitation which has, as we have seen in the dis-



EMERGENCY REPAIRS

Destroyer tenders are equipped with caissons by means of which damaged propellers may be renewed and minor underwater repairs may be made away from navy yards. Such repairs are being made here, the destroyer being tilted so that work may be done below the water line

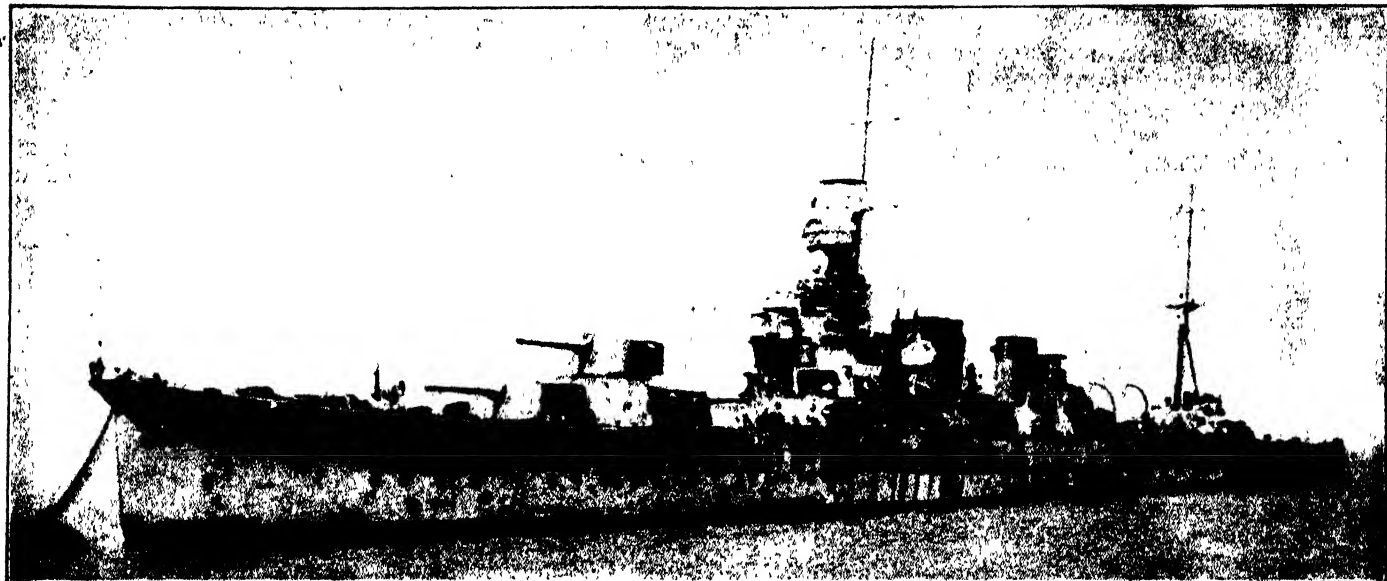
12 KNOTS AND OVER

	Ships	Tons
Great Britain	1280	9,532,508
Japan	206	1,169,190
United States	235	1,706,850

Recent construction of merchant vessels is strikingly illustrated by the following tables:

Ocean-going vessels of 2000 tons and over building during the

cussion of bases, a very material effect upon our naval strength in and about our possessions in the Far East. As explained before, the Japanese were unwilling to consider the limitation of any types of ships until we had agreed, by treaty, not to establish any fortifications in the Philippines, Samoa, the Aleutian Islands, or Guam. As this



"H. I. J. M. S. FURUTAKA"

A Japanese cruiser. By the novel gun arrangement shown, the Japanese are able to mount six eight-inch guns on a displacement of

less than 7500 tons and still obtain a speed of 33 knots by curtailing the supply of fuel and stores. Numerous bases enable them to do this

agreement did not mention the mainland of Asia, the question of British expansion in their leased territory of Kow Loon, opposite Hong Kong, is unsettled, and the treaty does not apply to islands east of the 110th meridian, which embraces Singapore.

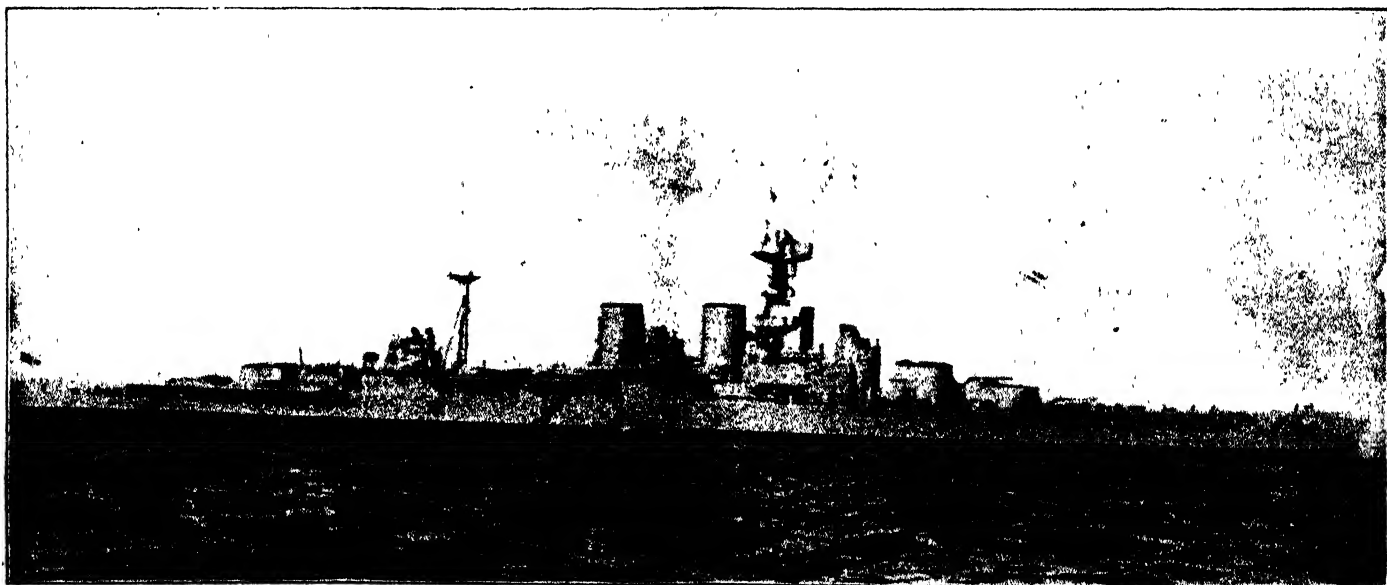
To summarize, then, the extent to which we can exert the potential strength of our capital ships and plane carriers in certain areas is limited. The British, and the Japanese as well, have an overwhelming cruiser strength. We are not able fully to utilize our great destroyer strength due to lack of destroyer leaders. Our submarines are mostly all of pre-war design and do not equal in strength or cruising ability the up-to-date Japanese force.

The fighting strength of a fleet depends to a great extent on the relation of the various types to the whole. Un-

less sufficiently strong in all types, a fleet will not be an efficient force and will not be able to exert the maximum strength of which it should be capable. Our present fleet is not only relatively, but actually, deficient in light cruisers, destroyer leaders, and modern submarines. These individual weaknesses lessen the strength of the whole fleet by throwing it out of balance in respect to types so that its strength is not the same as that indicated by its aggregate size and standardized tonnage in capital ships.

TO be adequate, also, a fleet must, besides being balanced, be strong enough as a whole to fulfill its normal mission of supporting the country's policies and successfully to defend it and its possessions from attack. To accomplish these purposes with our

standardized capital ship strength, experience, maneuvers, and study have indicated that a large tonnage of cruisers and of destroyers, including leaders, and a large number of submarines are needed to equip our battle fleet properly. These essential auxiliaries would furnish some protection for our commerce—which is fully as extensive and as important for us as for any other power—and would afford some assurance of protection to our interests in the Carribean and in the Pacific as far as Hawaii. Such a force would not furnish adequate protection to our possessions in the Far East or insure their continued possession by us nor would it overcome existing base deficiencies, but it would make our fleet an effective, efficient organization and a substantial insurance against war in the future.



THE GREATEST WAR VESSEL EVER BUILT

The British battle cruiser Hood. It is large enough to combine the high speed of a light cruiser with the gun-power and protection of a

heavily armored battle-ship. Its displacement is 41,800 tons, more than 7000 tons larger than any that may now be built under the treaty

"Movie" Film as Aid to Banking

THE Recordak is a machine designed primarily for bank use, and supplies the institution in which it is operated with a photographic record of all checks cashed or deposited. It is adapted to be used with any standard adding machine, its co-operation being automatic. Photographs are made as the checks are listed. It will make one picture of each check as they are passed through, or two pictures at the same time—these pictures being on different rolls of film.

Sixteen thousand checks are accommodated on a roll of safety film 16 millimeters wide and 200 feet long. By photographing the block numbers or file letters ahead of the checks, classification is made easy, and locating the facsimile of any particular check becomes a simple matter. An exact size image of any check concerning which there may be an inquiry can be

examined by projection on a small screen, or any enlargement may be printed in case a copy is necessary.

There are occasions when the ability to produce a facsimile of a cancelled check protects the bank against attempted fraud. Often-times also, the depositor has lost his voucher or is handicapped by a poor memory. Although the bookkeeper's entries show that the check in question has been cashed, the case is closed when an

machine. A double camera takes two pictures of each check, exposing parallel strips of film. These two originals provide a copy for the bank's files, and a record to accompany checks sent to out-of-town banks for collection. One camera may be operated alone if desired.

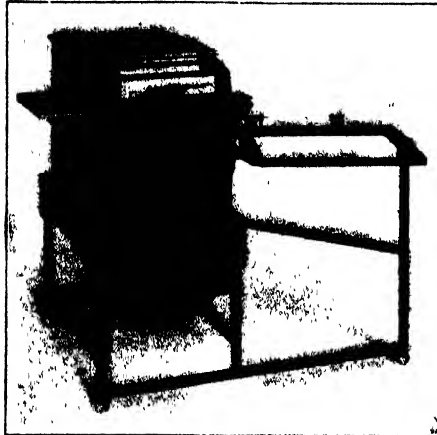
Seated at the adding machine, the operator drops each check, as it is listed, into a hopper on the ma-

FILMED CHECKS ➤

Sixteen thousand checks can be filmed on a two hundred foot reel. By photographing dates or file letters, classification is easy. Frames are examined with a projector.

chine. Touching the space-bar of the adding machine operates the Recordak as well. As checks are photographed, they are collected in a receptacle in their original order.

The camera is daylight loading and the exposed film may be removed at the close of business each day. The exposed film is processed and returned to the bank next morning, ready for projection. The cost is only one cent for each thirty checks photographed. Thousands of these copies of checks may be filed in the space occupied by a few of the originals. One large New York bank figures that the saving by this device is 12,500 dollars a year. The Eastman Kodak Company manufactures this unique business time saver.



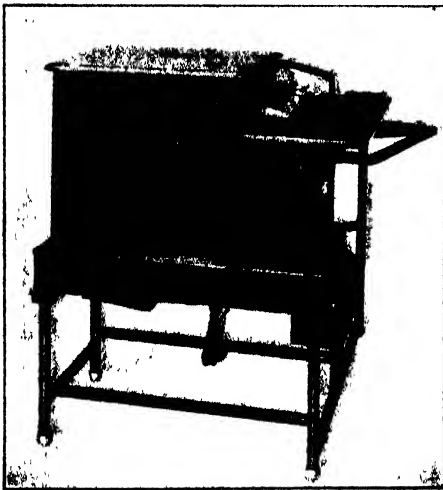
READY FOR ADDING MACHINE

The adding machine goes on the right. The adding machine button actuates the device.

image of the cancelled check itself appears on the screen.

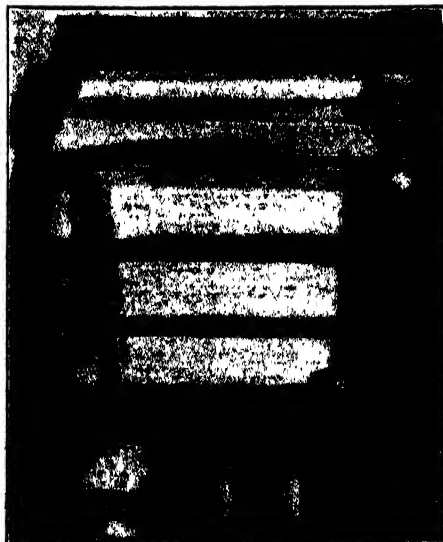
Although customer's checks are held only until the monthly statements go out, the photographic record may be filed permanently in a comparatively small space. A 100-foot roll of film occupies three and three-fourths by three and three-fourths inches, and in this space copies of 8000 checks are filed.

The device operates independently of, or in connection with, an adding



A NEW AID TO BANKING

The "Recordak" is a machine for recording checks photographically on a celluloid film.



CHECKS FACING THE LENS

Checks fed into a hopper are held on a curtain while two cameras expose films.



THE MACHINE IN OPERATION

Seated at the adding machine the operator drops each check as it is listed into a hopper. Eighty-five checks can be photographed in one minute by the device described in detail above.

The Month In Medical Science

A Review and Commentary on Progress in the Medical and Surgical Fields

By MORRIS FISHBEIN, M. D.

Editor of the Journal of the American Medical Association and of Hygeia

Vitamin B Deficiency In Infants

IN the Philippines, in Japan and in many tropical countries, beriberi develops because of the lack of vitamin B in the diet. Economic conditions force expectant or nursing mothers to live almost entirely on polished rice, and the infant fails to get its necessary quota of vitamin B, which is found in the unpolished rice. When vitamin B is absent from the diet, the most conspicuous symptoms are associated with the nervous system and they are so diffuse in character as to give the condition the name of polyneuritis. Infants with this disease are restless and fretful, pale and waxy in appearance, cry with a whining, feeble cry, have frequent attacks of colicky pain, and suffer with twitching of the face, rigidity of the neck, and even with convulsions.

Similar symptoms are, of course, not infrequently seen in this country, associated with infections and with inflammations of the brain. Dr. B. R. Hoobler of Detroit believes that not infrequently American infants are also given diets which are deficient in vitamin B. The usual diet of infants in the United States, up to the third month, consists of human milk or cow's milk, to which has been added sugar or syrup, and possibly milled cereals, with some orange juice and cod-liver oil. Such a diet is plentifully supplied with vitamins A, C and D, but vitamin B is present only in the milk and in the orange juice and in limited amounts.

In his investigations, Doctor Hoobler

supplied additional quantities of vitamin B to infants in the form of concentrates from brewer's yeast. It is his belief that every infant should have an addition of vitamin B to its formula and should not depend on milk, either human or cow's milk, as its only source of this vitamin. Experiments are now being made in the feeding of infants with added vitamin B with a view to determining whether or not the child's health and growth will not improve under such a regimen.

Denicotinized Tobacco

FOR some years the anti-tobacco organizations have waged such a persistent campaign against the weed that a market has developed for preparations of tobacco without nicotine. In their campaign, the adherents of the anti-tobacco movement have concentrated on nicotine as the most menacing ingredient in tobacco, notwithstanding the fact that tobacco smoke includes as well carbon monoxid, various sulphides, methyl alcohol, hydrocyanic acid, and many other substances that may be poisonous if taken in sufficient quantities. There are today dozens of denicotinized tobaccos and tobacco products on the market.

Chemical experts of the Connecticut Agricultural Experiment Station have recently made available their study of these preparations. The nicotine in tobacco varies from 2.5 to 3.5 percent for Virginia tobacco, 2 to 3 percent for various other domestic leaf tobaccos, 1.1 to 2.4 percent for Havana, and 1 to 1.5 percent for Turkish tobaccos.

Just as the ordinary tobaccos vary in their nicotine content, so also do the denicotinized products.

As a rule, these contain somewhat less nicotine than the tobacco leaf from which they are prepared. However, the lowest nicotine content found in any sample examined was about 0.75 percent, whereas some samples of ordinary tobacco may be as low as 0.50. Certainly many types of ordinary tobacco contain normally as little as 1 percent of nicotine. It is therefore obvious that no denicotinized tobacco has sufficient nicotine removed to warrant unrestricted indulgence on the part of the consumer.

It might be possible to remove nicotine completely, but chemical processes involved might at the same time utterly ruin it for any pleasurable effects from smoking. One of the difficulties of denicotinized preparations is that the consumer is likely to smoke far more, believing them to be without harm. In this way he gets nearly as much nicotine as if he did his usual amount of smoking with untreated tobacco, and at the same time far larger doses of the other constituents that have been mentioned.

Multiple Fingers

REGARDLESS of the fact that the condition occurs so frequently, all cases of multiple fingers and toes have interest. Dr. D. P. Penhallow recently described a case in which there was complete absence of the thumbs on each hand, each thumb being replaced by two complete fingers. In most of



MULTIPLE FINGERS

A dorsal view of the hands showing absence of thumbs, and the replacement of them by two complete digits. X-ray photograph of hands appears at the right



X-RAY OF MULTIPLE FINGERS

This view shows clearly the complete digital formation. The extra metacarpals and phalanges are perfectly formed

the cases that have been described, heredity played a part, but in the present case, which concerns a colored laborer 50 years of age, it was impossible to obtain a record of a similar instance in his ancestry. As shown in the pictures, in the place of each thumb there were two completely formed fingers resembling the third and fourth fingers. The right foot of the man was normal, but on the left foot there was a double great toe.

Mongolian Idiocy

SCIENTIFIC men recognize three grades of mental defectiveness—feeble mindedness, imbecility, and idiocy. It is possible to educate the feeble minded to the point where they may contribute their efforts toward self-support. The imbecile is uneducatable but can at least, in some instances, attend to himself. The idiot is so profoundly defective that his condition is practically hopeless. According to the Binet-Simon intelligence scale, persons who have a mental age of seven to twelve years are morons; those with a mental age between three and seven are imbeciles, and those who have not progressed beyond the age of three mentally are idiots.

One of the most peculiar forms of idiocy is that called mongolism. According to a view recently expressed by W. M. Van der Scheer, Mongolian idiocy is due to the effects of degenerative processes in the ovum before the child is born. The Mongolian idiot is marked by abnormalities of the face, jaws, nose, and eyes, which give it a Chinese or Oriental appearance. After the birth, other degenerative changes take place which seem

to be due to the failure of adequate development of the brain.

Many explanations have been advanced as to the nature of the process that attacks the infant before birth. Glandular processes and syphilis have been alleged to be primarily responsible. On the other hand some investigators assert definitely that the changes are atavistic and represent an attempt to return to early stages in human evolution. Some observers have asserted that the Mongolian idiot is always the last of a long series of births, others that it results from the fact that the mother may be too old at the time the child is born. Actually the scientific evidence is not sufficient to support either of these conceptions.

Round Worms in the Human Body

THE ascaris or round worm is an unusual but not an infrequent inhabitant of the human body. The ascaris, as shown in the illustration, is a round worm of which the male is 15



EXTRA TOE

In this curious case, the right foot is normal, but on the left is a bifurcated big toe



SUPERNUMERARY PHALANGES

This X-ray photograph is of the left foot shown in the center of the second column

to 25 centimeters in length and 3 millimeters thick. The female is 20 to 40 centimeters long and 5 millimeters thick. It is strongly muscular and can wriggle with strong contractions. Its eggs are laid in the intestines of the human body and are spread by passage from the intestines so that they may contaminate food, drinking water, or be carried directly by the hands. It has been shown that the larvæ wander through the human body before settling down to develop.

Large masses of these worms have been found obstructing the intestines, so that surgical operation was necessary for their removal. It has been noted that they tend to be vomited from the body in times of crisis in disease, or just before death.

A recent report by Dr. C. B. Morton collects a considerable number of cases in which this worm had developed in the gall-bladder. The problem that puzzles the surgeon is how this worm gets into the gall-bladder. One must assume that the egg hatches out in the gall-bladder or that a small worm migrates from the intestines through the tiny passage that carries the bile from the gall-bladder to the intestines.

Another case has occurred in which a tapeworm ten feet long was found in the gall-bladder. Seven cases have been reported of the finding of round worms in the gall-bladder. In the case seen by Doctor Morton, the patient was a woman 45 years of age who had



WORM AND GALL BLADDER

In the report starting at the left, several instances of worms in the human body are cited. The photograph shows an ascaris and the gall-bladder of a human being from which it was removed after an operation

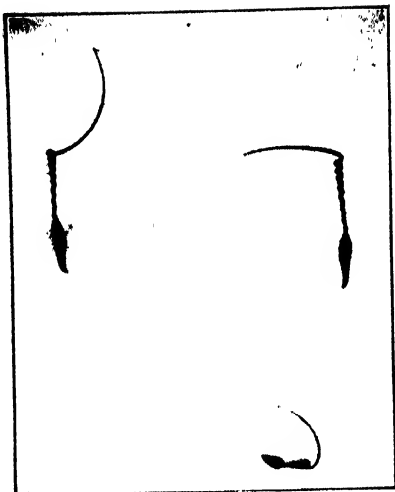
suffered repeatedly with pains in the abdomen in the region of the gall-bladder. The only indication that a worm inhabitant was present in her gall-bladder came out after the operation when careful questioning revealed the fact that the patient was nauseated and vomited a round worm 15 centimeters long the day before the operation.

The Washing of Tin Cans

AN examination made of unwashed cans in New England canneries revealed bacterial counts as high as 162,000 per can. Indeed, cans just out of the machine contained a considerable number of bacteria, although not so many as in those which had stood for some time.

In the modern process of canning, the can with the food inside is subjected to high temperature under pressure for a considerable period of time. The amount of time necessary and the temperature required have been calculated on the basis of the possible bacterial contamination. If, however, the cans contain an unduly large number of bacteria previous to the sterilization, it is unreasonable to expect that all of the germs will be destroyed. For this reason, the canning industry has made a special study of the possibilities from the unwashed can and at least one group of manufacturers, the fish canning industry of the Pacific Coast, has gone on record as advocating the use of all washed cans as an additional sanitary measure and safeguard to the food supply.

The housewife who does her own canning will realize the importance of thorough washing, indeed actual boiling, of jars and tin cans before they are used for packing purposes. This is particularly desirable when empty fruit jars are held over for use year after year.



THREE DRIED SEEDS

When detached, the awns (tails) will dry and curl in a few minutes

DID you ever notice a carpenter or an electrician boring a hole somewhere about the house, close to a wall or in a corner where he could not turn the auger completely around and had to turn it back and forth? This he does with a ratchet brace and bit—really a very ingenious and intricate mechanism. The fellow who first thought it out did some tall thinking, but “why should the spirit of mortal be proud?”—this article tells of a lowly plant, a mere blade of grass, that had this ratchet brace and bit all figured out and put to good use long before man existed.

The “brace and bit plant” belongs to the geranium or crane’s-bill family. The seed pod looks like a crane’s bill because of the long stems attached to the seed, several of which grow bunched together.

That the seeds of some plants bury

themselves has been known to students of botany for a long time, but there seems to be no record of the true interpretation of how this curious feat is accomplished. The mechanism with which nature has supplied these seeds is a veritable counterpart of the ratchet brace and bit, except that it is an improvement on it in two respects: it is automatic, and the bit will bore when turned in either direction. By means of this versatile mechanism the seed is buried several inches below the surface of the ground, evidently to protect it against heat and drought.

A CASUAL observation of the peculiar plant leaves the impression that its seed appendages are simply a form of burr designed to insure them wide distribution. The seed with its appendage, when fresh from the plant, looks like a small spear about three or four inches long. If one holds the head of the spear stationary, the opposite



THE BRACE AND BIT PLANT WITH ITS SEEDS

Each of the seed pods (stork’s bill in appearance, hence the plant’s name, “stork’s bill”) consists of several seeds with awns. When these are separated, the drying and curling process begins

The Brace and Bit Plant

The Seed of the Bizarre Colorado Grass Automatically Bores Its Way Deep Into the Soil

By OLIVER B. FINN, A.B., A.M., M.E.

With Drawings by the Author

Nature’s Unpatented Invention

ERODIUM is the scientific name of the “brace and bit” plant. It belongs to the group which includes the common geranium. In all there are some 65 species of *erodium*, chiefly confined to the western states. The author of the accompanying article kindly sent the editor a sample of the plant and as a result, not much work was accomplished in the editorial rooms during the remainder of the day—so much fun was had playing with the little seeds or carpels whose antics are not at all exaggerated by the author. Nature provides some odd wrinkles for distributing seeds.

The Editor.

end for about one fourth of its length will soon be observed to bend slowly over, until it is at right angles to the remainder of the stem, and will become slightly curved like a sickle. Then this end, like the hand of a clock, begins to go around, and will continue to move for several minutes, until the main stem is twisted spirally from end to end like an auger, and until it becomes perfectly dry. If it is now moistened it will unwind, turning in the reverse direction until it is again saturated with moisture.

THE discovery of this life-like power of movement prompted an investigation, for it was reasoned that it must have some relation to the economy of the plant. Although great numbers of the dried twisted seeds were found on the surface of the ground, under the plants which grew them, a closer search revealed many of the seeds having only the bent-over ends projecting above the surface. Upon digging the soil away from these, the main stem was found with the spear-like head containing the seeds proper at its lower end. Some of the seeds had actually reached a depth of four and five inches.

An analysis of this remarkable mechanism reveals the following information: the stem or "awn" of the seed is hygroscopic, that is, it has the power of quickly absorbing moisture and as quickly drying. When moist the awn is straight, but when dry it is twisted like an auger. Rain, humid atmosphere or the dews, untwist the awn, while the succeeding warmth of the sun or dry air or soil twists it up again.

At the seed end of the awn there is a hard, sharp point fringed with short, flexible hairs that form a feather-like blade. These hairs have a double purpose. When the awn is twisting, the pressure of the soil on one side bends them over slightly and the resulting curved surface acts like that of a ship's propeller and drives the seed downward into the soil.

THIS is the result whichever direction the seed turns. The hairs on the seed end of the awn and the smaller ones throughout its length act like the barb on a fish hook, preventing the seed from moving backwards out of the ground, once it is driven into it.

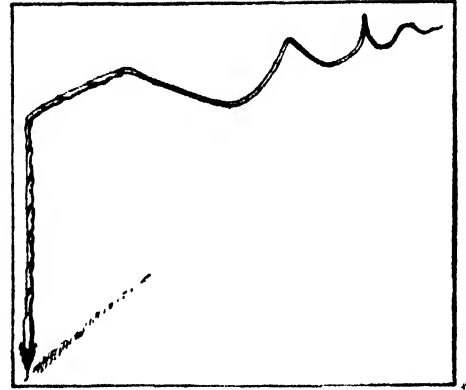
The hairs and the sharp point to which they are attached form the "bit" of the "auger;" the bent over end of the awn forms the "ratchet;" and any blade of grass, stick or stone, acts as the "pawl," holding the ratchet stationary when, in twisting up, it presents its concave side, but allowing it to slip by when it reverses its direction in unwinding. When the "ratchet" is held still, the "bit" is compelled to turn and forces its way into the soil, but when the ratchet slips past the pawl the bit remains still, exactly as in the ratchet brace and bit. The lower end of the point is slightly curved so that when it twists around, it "breaks ground" for the full size of the seed to follow.

One of the plants which has this peculiar seed-preserving device grows in great abundance in California, and in the wet season furnishes rich graz-

ing for cattle and sheep. In the dry season these pastures are baked hard and are devoid of any sign of vegetation. Deep down in the soil, however, the seed is waiting in safety for growing weather when it will be turned into most beautiful and luxuriant verdure.

The accompanying illustrations show the seed in the various stages of planting itself automatically.

In some varieties there are additional appendages to the upper end of the awn. One found in Colorado has a long wire-like end which curls up like



SEED AND POINT

Another genus of the same peculiar order of plants is called the "crane's bill"



THE BUSINESS END

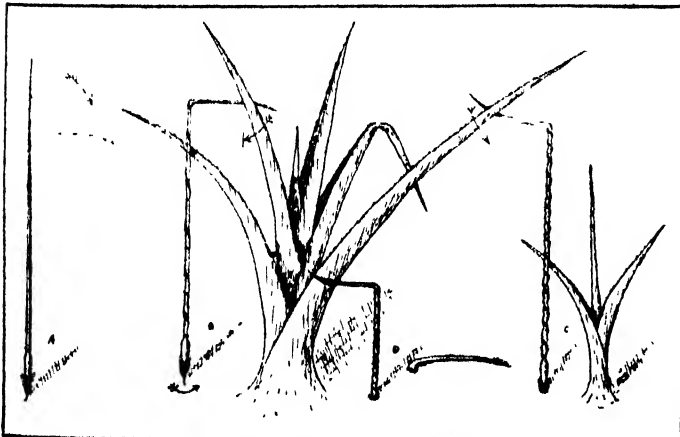
The curved point bores somewhat on the cutting principle of the expansion bit

a corkscrew or straightens out again, according to the variations in amount of humidity. This gives the seed a greater reach, and therefore gives it a greater chance of using its boring power, which is ineffectual unless the ratchet comes in contact with something that acts as a pawl to hold it still. When this corkscrew-like end curls up, it presses against any overhead obstruction that it can reach and "braces" the bit, thus helping it to force its way into the ground.

One of these self-planting seeds, found in southern Europe, has a

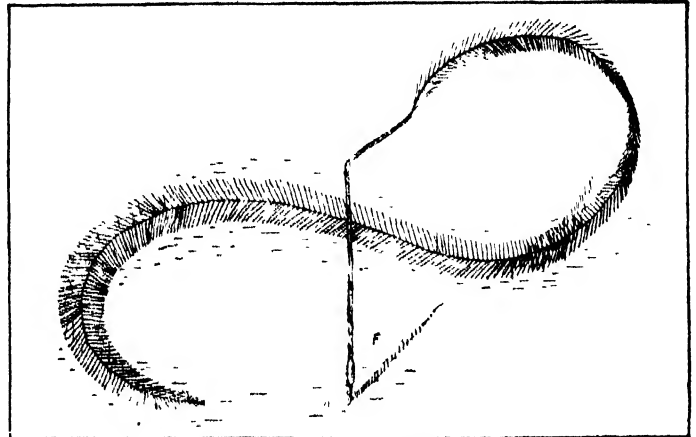
feather-like prolongation of the awn nearly a foot long, to which is ascribed the function of flight; that is, it is easily picked up by the wind and carried long distances from its parent plant, where it proceeds to bore into the ground. Botanists have attributed the power of self-planting simply to the downward push resulting from the bending over and straightening out of the end of the awn. This mechanism, with slight variations for adapting it to different conditions, is found in the seed of a number of plants which are in no way related to one another.

SOME of these seeds have long hairs which, when the seeds begin to twist, bristle out and prop them up so that they can get a start into the soil—very much as a gang of men will prop up a telegraph pole with long sticks in order to start it into the hole dug for it. These hairs also serve to catch and hold a drop of rain or dew, and as fast as it moistens and straightens out the awn, to push it up along the awn until the latter is completely untwisted, ready to dry and bore again—simulating a water elevator. Here is food for thought: A blade of grass with no thinking organs, achieving such a wonderful and economical use of its apparently useless parts.



HOW THE SEED DIGS ITSELF IN

At A it has fallen; at B the awn is ratcheting against a blade of grass; at C (right) the awn, in reverse, is slipping past the pawl; D boring



AN AIRBORNE EUROPEAN RELATIVE

Stipa pennata is the name of this grass from southern Europe whose awn is long enough (12 inches) to permit flight before boring in



DOWN THE HUMP

Classification tracks seen from the hump. The cars go down by gravity, are shunted to the proper tracks by electrical switches, and are slowed down by retarders like that shown in circle

Speeding Up a Railroad Yard

Automatic Switching Equipment Takes the Place of Yardmen for Sorting Cars in a Freight Terminal

By JAMES R. RANDOLPH

FREIGHT cars have to change trains, the same as passengers do. At some point in their journey they have to be sorted, and re-grouped into trains bound for their destinations or the divisions on which their destinations lie.

To do this sorting is the business of a classification yard, such as the one at Mechanicville, New York, which forms the western gateway to the Boston and Maine Railroad, and the territory lying to the east of it. To this yard come freight trains from the west and the south, and here they are broken up and made into trains for the various terminals throughout northern New England. Local freights, including cars for the small towns and factory sidings on some of the divisions, are also made up here. These cars have to be arranged in the order in which they are to be dropped off, so that those for each siding will be in the most convenient place in the train when that siding is reached.

THE method of sorting in this yard is to push the train over a hump, from which all the classification tracks spread out fan-like down grade. Here the cars are uncoupled in "cuts" of one or more cars destined for the same track, and go down to their tracks by gravity. Formerly each cut was ridden by a yardman who applied the brakes to control speed.

In bad weather, however, this work was hard and dangerous, and at all times a large crew of men was required.

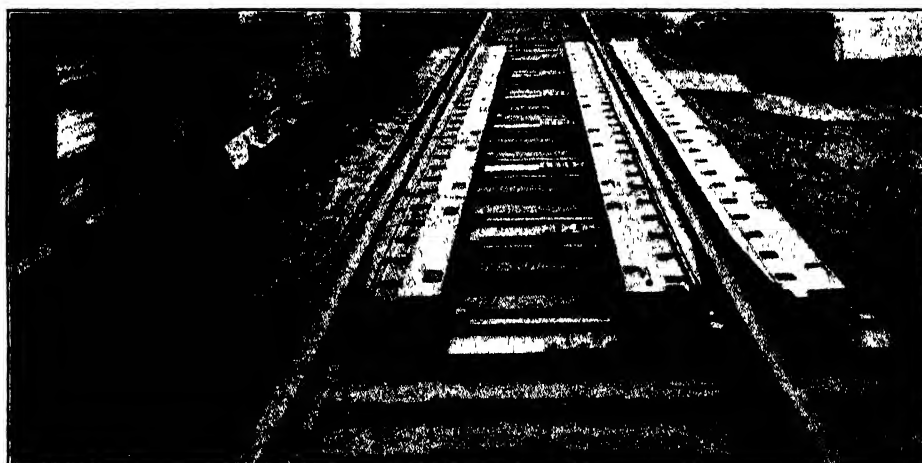
Within recent months the Mechanicville yard has been made over with new grades, new tracks, and the latest modern devices to facilitate the work. The riders on the cuts and the men at the switches are now a thing of the past. The cars are switched to the proper tracks and their speed is controlled by small levers operated by men seated in comfortable towers.

The new yard was officially opened recently by President Hannauer and other Boston and Maine officials, in the

presence of prominent visitors from New York and New England.

With its new equipment the yard has proved able to sort cars and place them in the outgoing trains in less than half the time previously necessary. As a result, hours of time are saved in the delivery of freight. This is especially valuable in handling perishable freight, of which a great deal goes to New England.

WITH one man in each of the two control towers, the yard can handle 150 cars per hour. The towers are equipped for duplicate control, and



FOR RETARDING THE CARS

A close-up of a retarder. Electrically operated springs beneath the rail draw the steel shoes together so that they squeeze the flanges and outer rims of car wheels in order to slow down a car

with two men in each, 250 cars per hour can be handled.

Experience has shown so far that damage to cars and contents that sometimes occurs with the old hand control methods has been eliminated. Danger to men has been done away with.

Chief of the features of the new yard are the car retarders, of which President Hannauer is co-inventor and of which there are 17 in the yard. They are so placed that cars may be run down from the hump at a moderate speed and then slowed down before reaching the classification tracks to a speed of three or four miles per hour, at which speed they can couple without damage to cars that are standing on the tracks.

EACH retarder has several pairs of heavy steel shoes, the shoes of a pair being opposite each other on each side of the rail. Springs beneath the rail draw the shoes together with a tension that may be varied by electric control from the tower. The retarders are set according to the weight of the car and the change of speed desired. The switches are also controlled electrically from the tower.

In other ways, also, the yard is well equipped. When a train arrives on one of the tracks in the receiving yard the conductor sends his way bills through a pneumatic tube to the yard office. From them the yard clerk makes out the switching list, giving car initial and number, weight, classification track, and destination.

This list is written on a teletype, or electric typewriter, which makes four copies at once—one in the yard office, one in the hump cabin, and one in each of the two towers. Thus each operator is told just what to do with each car in the train. Formerly each of a number of switchmen had to have a carbon copy of this list, and much time was required to reach each individual.



THE HUMP CABIN

Operators in this cabin keep a record of the cars as they start rolling down the incline

As the train is pushed upon the hump, the hump conductor notifies the tower man which train is coming, and gives any special instructions that may be needed. These are given over a telephone equipped with loud speakers at both ends so that there is no bother in getting a connection.

AT night the yard is well lighted with flood lights. The hump signal, which is repeated at three points, has four colored lights with which to signal the engineman how to handle the train. This signal is repeated in the first tower, and the towerman there can set it to the stop position should he desire to do so. Klaxons are provided to supplement the lights in foggy weather. Provision is made for forcing hot oil into the journal boxes of the cars in cold weather so that the cars will always roll freely. Towers and hump cabin are at all times comfortably heated.

Because electricity plays such an

important part in the operation of the yard, great care is taken to insure a continuous supply. Power is available from two outside sources, and the yard is equipped with storage batteries in case both sources should fail at once. These batteries may be charged from either source, and are sufficiently large to run the yard for several hours.

There are 10 tracks in the receiving yard, each long enough for a whole train. In the classification yard there are 36 tracks, with a total capacity of 1930 cars. At the lower end are six doubling-over leads, where six new trains can be put together without blocking each other's switching.

Beside the hump, on the north, is a transfer yard holding 237 cars, for freight that must be moved from one car to another. On the other side is a cripple yard, holding 240 cars, and provided with a car repair shop. Here, also, are cattle sheds for feeding live stock, and ice houses for re-icing refrigerator cars.

At the lower end of the yard are the roundhouse, the locomotive shop, cinder pits, and other equipment needed for the care of the motive power.

MECHANICVILLE is just north of Albany, on the western side of the Hudson River. There is a natural down grade in the direction of freight movement, and this has been regulated to meet the needs of the different parts of the yard. In the receiving yard this grade is 0.36 percent and it increases slightly in going down to the hump. On the western side of the hump there is a short up-grade to give slack for uncoupling, and then, on the eastern side, a down-grade reaching a maximum of 4 percent. This eases off as the switches are passed to a grade of one fourth of 1 percent, which continues throughout the yard. In the retarders the grade is steep enough to get the cars started in case they stop there.



ELECTRICAL SWITCHES

In the left background is the control tower from which the switches in the foreground are operated. In the center background is the hump

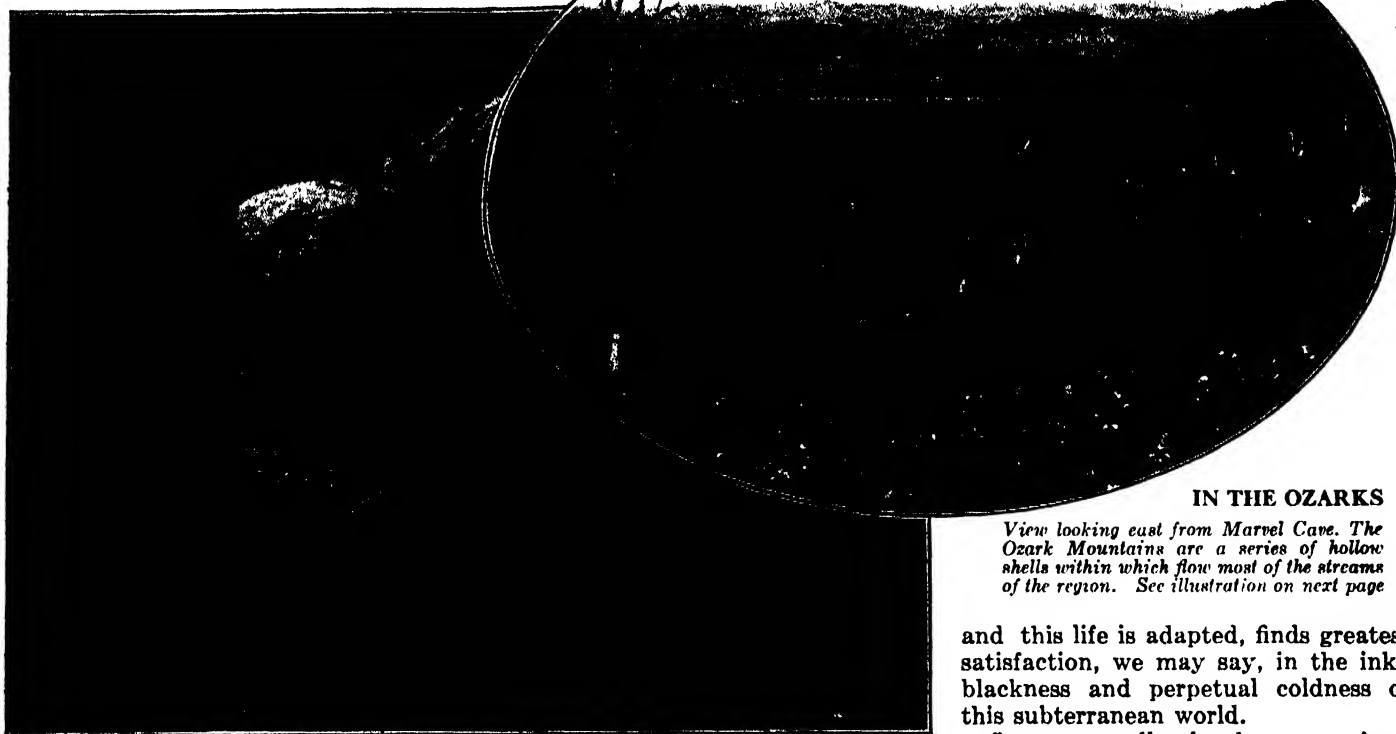


THE CONTROL BOARD

President Hannauer of the Boston and Maine at the switchboard in one of the towers. Levers operate the electrical switches and retarders

ENTRANCE TO MARVEL CAVE

Below: The descent into this home of the "creatures of perpetual night" is made through the roof of an enormous underground chamber nearly 200 feet high. In the illustration, note the man in the lower right corner, toiling up the pile of debris



IN THE OZARKS

View looking east from Marvel Cave. The Ozark Mountains are a series of hollow shells within which flow most of the streams of the region. See illustration on next page

Creatures of Perpetual Night

An Account of An Expedition to the Ozarks in Search of the Blind Salamander

By G. KINGSLEY NOBLE

Curator, Amphibians and Reptiles, American Museum of Natural History

FROM the Appalachians to the Rockies the vast plains of the continental interior extend some 1200 miles, the thick layers of sediment nearly as even and unwrinkled as when first laid down. From Carboniferous time when the beds of the Mississippi Valley were finally raised above the level of the shallow inland sea until today, the great basin which forms so large a part of the United States has remained a lowland, now rising, now sinking, but never oscillating far in either direction.

Only in the Ozark region have orogenic forces pushed up the beds of Paleozoic limestone into steep, rocky hills. Limestone is poor material with which to build great mountains. The rains soon smooth off all prominent features, and the water, acidified by the decaying vegetation of the slopes, seeps through the porous rock to carve for itself innumerable channels and chambers within the heart of the hills.

The Ozarks, seamed and wrinkled, remain throughout most of the year a series of dry shells within which the subterranean waters flow for miles before bursting forth at the base of the hills to join the larger rivers of the lowlands.

THE devious passageways and water channels which honeycomb the Ozarks have always held a strange fascination for the hardy peoples who settled in southern Missouri and northern Arkansas. The more accessible caves, especially those rich in stalactites and stalagmites, were soon explored, but there remained dozens of other more extensive caves which seemed to defy the entrance of man. Yet into these crooked, winding passageways adventurers finally penetrated, and we now know that the heart of the Ozarks is not formed merely of cold, stony, dripping chambers. An abundance of life is present

and this life is adapted, finds greatest satisfaction, we may say, in the inky blackness and perpetual coldness of this subterranean world.

One may well ask why any animal should prefer to live so far removed from the outer world. Naturalists for a century have asked this very question. And some of the most distinguished among them, such as E. D. Cope, have visited the Ozarks to gain better acquaintance with the cave fauna. Most cave animals are blind, their bodies white and ghostly translucent in the light of a torch. Many are equipped with a rich growth of sense papillæ, or bristles, with which they feel instead of see approaching enemies and prey.

WHAT have been the causes of these changes? Use and disuse, the older naturalists replied, but such an explanation does not receive any support from the vast amount of experimental data provided by modern biology. Hence, it seemed advisable to penetrate once more into the Ozark caves to determine more accurately the environmental factors and further to secure living material in sufficient quantity for an experimental analysis.

Most of the cave entrances in the Ozarks are far off the main highway, usually at the foot of some hill. As the roads generally follow the ridges, there was ample opportunity for me to get acquainted with the fauna of the outer world. The hills on closer acquaintance proved to be steep piles of small limestone chips among which there struggled a thick growth of deciduous woods. Descending a slope was like walking down a coal pile, the chips giving way at every step. In

such a terrain devoid of anything that can be called soil, moisture can remain but a short time, and as September had been a very dry month, the loose stones noisily announced our approach with a metallic clatter. The first to be frightened by the intruders was a blue-tailed skink which scurried away in the brush. Turning over adjacent logs we captured two others. This lizard and its close relative, the coal skink, we met very frequently in the hills. The slim-bodied skink was found in the same situations, and on the more exposed slopes we caught the collared lizard.

Our first descent into the lowlands revealed that snakes were far more abundant than in any other place I have visited. The most conspicuous was the mountain black snake, but the individuals we met were not like our New Jersey friends; they were flecked above with white, and blotched below with black. Here was an incipient species not yet sufficiently demarcated from its eastern relatives to be called a distinct race. On these arid slopes a dark coloration would seem entirely out of place, but all the

"news bee," a fly which is colored exactly like a queen yellow jacket and has the form, color, and sound of the same unpleasant acquaintance. Here was an instance of mimicry, the fly supposedly gaining protection by this mummery. Natural selection working on a host of color varieties in an ancestral fly picked out this noisy yellow and black fellow, recognizing by this very act that bluff and noise will sometimes carry one a long way toward success.

THE entrance to Marvel Cave, the largest Missouri cave I explored, is through one of two openings in the roof of an enormous subterranean chamber nearly 200 feet high, 400 feet long, and 225 feet wide. A pile of stone debris forms a hill about 125 feet high under the openings and the descent to its summit is managed by a wooden stairway. The latter is maintained by Miss Genevieve Lynch, the owner of the cave, who for some years has opened the cave to visitors.

The few tourists who come to this little-known region follow a guide to the far end of the chamber where a tortuous passageway twists back and forth, digging deep into the ground until it reaches the water course made by Lost River. The lowest point of the journey is reached at the foot of the waterfall which has been determined as 480 feet below the surface of the ground. Throughout the long route followed by tourists, blind salamanders have never, in recent years, been seen. It was our plan to begin where the tourist

turns back, namely, at the foot of the waterfall. A hole half way up a bank of soft red clay indicates the opening of the passageway to Blondie's Throne.

Previous experience had taught us that cave exploration is very wet, sticky work. One crawls or wallows forward in adhesive mud far more often than one ever stands. Our party consisted of Byron C. Marshall, a herpetologist of Arkansas, Clark Gallaher, head guide of Marvel Cave, and myself. The bank proved as soft as it looked, and we were all smeared with mud before we reached the entrance and began the long crawl. Marshall and I were armed with electric torches and collecting tins, while Gallaher managed a gasoline lantern, the first, no doubt, ever carried in this narrow passage.

BLONDIE'S THRONE is probably not more than 400 feet from the waterfall, but as much of the distance is covered flat on one's stomach, the trip required over an hour. The passageway probably averages two feet high and four broad. The mud of the waterfall room soon gives way to sheets of limestone and dripstone of colors varying from black to yellow. The floor of the passage is made anything but comfortable by a series of more or less connected pools containing water of 58 degrees, Fahrenheit. We dragged ourselves slowly through the water and found that life was abundant in this inky passage. A black gnat which we had seen in other caves was here in numbers, some black beetles were seen walking over the rocks, while the pools contained a colorless crustacean.



A BLIND SALAMANDER

This creature, Typhlotriton spelaeus, was the goal of the expedition described here

racers we saw were handsomely clothed in satiny black. Copperheads, we soon discovered, were very common, and after we had captured our first, a few feet from the trail, the almost perfect concealing coloration of this serpent assumed for us a new interest.

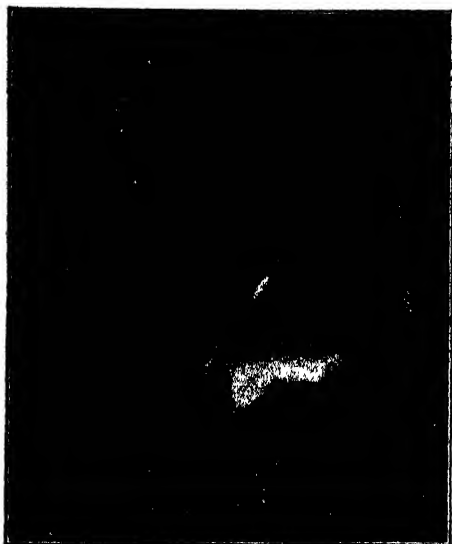
Only a very small part of the Ozark fauna seemed concealingly colored and a few creatures were obviously the reverse. One that thrust itself upon us from the first was that of the noisy



All photographs courtesy of The American Museum of Natural History

CATCHING A "GRAY GHOST"

The blind salamander, called the "gray ghost," frequents the edges of small underground streams and pools. The blind salamander of the Ozark region is terrestrial in its habits when full grown



RESTING

A stop between crawls is imperative because of the arduous nature of this mode of travel

We came upon our first blind salamander shortly after beginning the crawl. It was walking rapidly over the loose stones in an effort to escape. In the light of the gasoline lantern its pale tones gave it a most unreal appearance. The beast looked more like some creature fashioned out of dough than a living organism. Its dark eyeballs shone through the translucent lids and gave it a peculiar expression. But once the creature was in the collecting tin it appeared more animate.

WE reached Blondie's Throne without encountering any other salamanders. But the bats which dashed past us as we crawled frequently misjudged the distances and rudely brushed us with their wings. Blondie's Throne proved to be a great vault of gray dripstone. A crawl of ten feet up a bank of slippery clay brought us to the main entrance to the room. The ceiling, some forty feet overhead, seemed to swirl about in the bright gleam of our spot lights. The squeaking and the continuous rain of excrement disclosed that the "ceiling" was in fact in motion. Myriads of bats circled about overhead, the beating of their wings sounding like the rhythmic puffing of a distant locomotive.

The room is partly filled by a tremendous stalagmite or throne above which a canopy of stalactites gracefully droops. But the festoons of black drapery on either side of the throne soon began to flutter, and I realized that they were great masses of bats holding tightly to one another's backs. A closer inspection showed that thick rugs at the foot of the throne were sheets of reeking bat guano in which one sank half way to the knee. The odor was stifling, the noise bewildering, and yet the grandeur and magnitude of the throne room with its walls ornamented with dripstone held us spellbound. It was half an hour be-

fore we began our perilous descent to the stream bed.

Beyond Blondie's Throne the passageway grows even more difficult as the pools become more frequent and deeper. But here collecting began in earnest. We soon caught one blind salamander under a stone beside a pool, and another that tried to slide past us in the narrow passage. But



RETURNING WITH THE SPOILS

The explorer's burden consists of living blind salamanders packed in quantities of ice

most surprising was still another which, when we disturbed it at the edge of a pool, made straight up a sloping bank toward a hole under the roof of the passage. Thus, these creatures with their sightless eyes must have well defined routes of travel and escape. By frequently touching their snouts to the ground they are able to make considerable speed between the

loose pieces of lime and dripstone which floor their passageways.

Later we made other trips to Blondie's Throne and to near-by caves, which presented equally difficult crawls. None of these was as successful as our first. The crawl farther up Mystic River almost ended in disaster. Just as our party were attempting one of the worst squeezes, a swarm of several thousand bats started through the same opening. The squeaking, fluttering hordes almost stifled John, our guide, who was in the lead. They crawled up his trouser legs and down the open neck of his shirt. When they began to pile up as a solid, squirming wall directly across the crevice, the thought of whether there was enough oxygen for all struck the members of the party at the same time, and without awaiting for further demonstration a retreat was at once begun.

IN transporting and handling our salamanders many problems presented themselves. The young, or larvæ, we discovered lived for several years outside of caves in the springs which were fed by the underground streams. In order to bring larvæ from the surrounding springs to our base camp at Marvel Cave we found it necessary to carry the containers on ice. Further, the larvæ shipped better in wet leaves than in water. All these facts were learned only with the sacrifice of life. By constant vigilance and care we have managed to bring several hundred larvæ alive back to New York, where they are now available for laboratory studies which we believe will throw further light on the importance of environmental versus hereditary factors in the origin of blindness and depigmentation in the cave salamander.



STARING WITH SIGHTLESS EYES

The blind crayfish, Cambarus setosus, is the color of bleached bone. Its eyes are rudimentary, but like other subterranean animals, its sense of touch is greatly refined. Its pincers are strong

Stocking Up An Expedition's Larders

Byrd's Three Ships, Bound For the Antarctic, Are Loaded With Necessities and Incidentals For a Long, Hard Trip

By V. I. COOPER

WHEN the Byrd Antarctic Expedition was organized, approximately 750,000 dollars had to be raised, partly in money, and to a certain extent in materials.

Some people and firms gave in dollars and cents, according to Sidney Greason, purchasing agent of the expedition; others, like Henry Ford, contributed equipment. The Maxwell Coffee House donated the expedition's coffee; the National Carbon Company, lamps; the Radio Corporation of America, radio equipment; the General Box Company, containers; and Swift and Company, 3500 pounds of butter, packed in six-pound hermetically sealed tins, coated with Dupont waterproof paint on both ends to insure that the butter will be kept air tight, not only in the Antarctic but through that tropic zone which all three ships of the expedition must pass on their long voyage from New York to Dunedin, New Zealand. Dunedin is the last port of call before the lonely trip begins across 2300 miles of the world's stormiest sea and iceberg-infested waters through which, at certain seasons, no vessel can progress at all, to the camp at Bay of Whales, Antarctica.

UNQUESTIONABLY, the Byrd Antarctic Expedition is more completely equipped than any that has attempted to explore the frozen wastes of either the north or south polar region in the past, chiefly because the man at the head of it, Commander Richard E. Byrd, knows that its entire success depends upon the maintenance of the welfare and health of 76 men throughout 18 months—perhaps more—filled with hardships that will try each member of the party to the very limit of human endurance.

One hundred percent physically fit at the start, the men of the expedition are to be kept that way, and every means of assuring this result has been employed. No contingency has been overlooked.

One of the first considerations, naturally, was food. The three ships of the expedition—*City of New York*, *Port Hunter*, and *Chelsea*—(renamed the *Eleanor Bolling* after Byrd's mother)—will carry, among other items, 4000 pounds of pork loins, 2000 pounds of fresh hams, two tons of smoked hams, three tons of bacon, one half ton each of lamb and mutton,

one ton of veal, two tons of corned beef, one ton each of corned tongue and corned shoulders, five tons of beef, 3500 Golden West fowl from Iowa, and 1500 pounds of calves' livers packed in 10-pound tins and thoroughly frozen before being put into the *Port Hunter's* ice chambers, which will carry the bulk of the refrigerated supplies. This is probably the first time in expeditionary history that calves' livers have been included in the dietary, and this is so because of the high vitamin content. Even the lowly "red hot" will find its place on the Antarctic menu! One thousand pounds of frankfurters are in the refrigerator!

To name a few staple products,

there are 10 tons of sugar, 200 cases of canned milk, 2000 pounds of dried milk, 50 gallons of lime cup, several cases of grape juice, nuts and raisins, and five tons of flour. The eggs, according to the present plan, will be bought in Dunedin, New Zealand. They must be sterile and unfertile, and the price in New Zealand is thought to be cheaper. Not once has Commander Byrd forgotten that the public is financing his expedition, and that its money must be conserved.

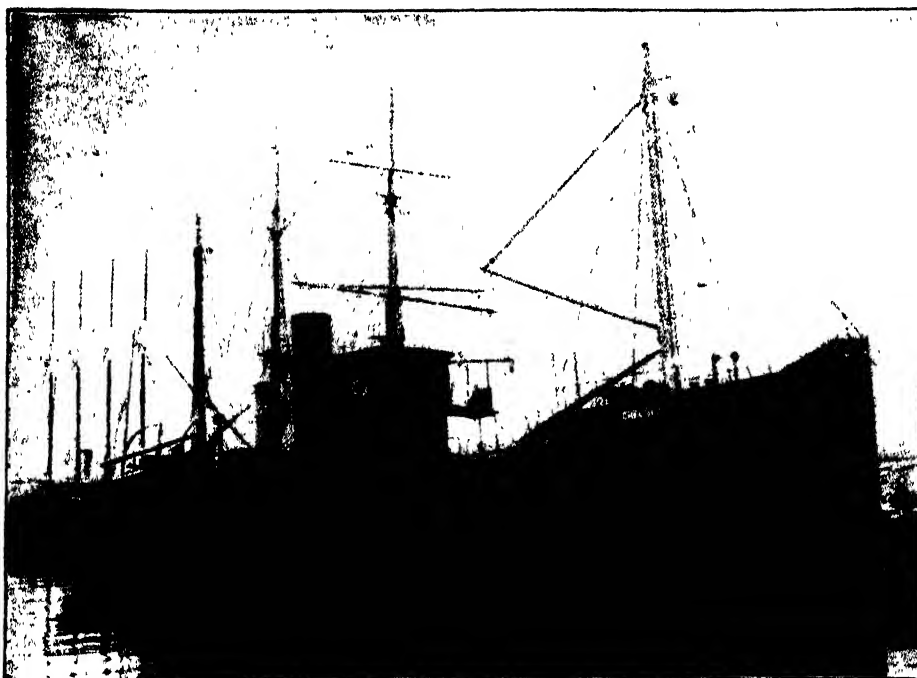
Each case of supplies is specially labeled to conserve time and energy. A few of the labels are:

Commissary—Red pennant
Medical—Red Cross



COMMANDER BYRD'S FLAG-SHIP

The ice-cutter, the *City of New York*, formerly the *Samson*, which will be Byrd's headquarters. Over his desk in this ship will hang a photograph of Floyd Bennett, in tribute to his memory.



THE EXPEDITION'S AIRPLANE CARRIER

The former Chelsea, renamed the Eleanor Bolling in honor of Commander Byrd's mother, which will carry the airplanes and the parts and machinery for their possible repair while in the Antarctic

Flight—Arrow
Science—Triangle
Radio—Tower
Issue Expedition—Black ball
Ammunition—Red ball
Dog gear—Diamond

Fresh vegetables will be taken from New York—indeed, watermelons are aboard the *City of New York* and other supplies will be taken on in Dunedin. Five thousand pounds of dried potatoes will be added there.

EVERY member of the expedition is to have turkey on Christmas day, with plenty of cranberry sauce, and there will be turkey on other holidays as well, because 2500 Maryland turkeys will go a long way. And while the "boys" are waiting for Christmas there is plenty of gum for them to chew—500 pounds—and countless cigarettes to smoke—1000 pounds each of cigarettes and tobacco.

There will be plenty to eat when the men set up housekeeping in the portable hungalows now aboard the *City of New York*, and if they experience a Vitamin B deficiency during the long, sunless winter months, they can spread their bread with Vitavose—a wheat germ product, that is both tonic and food, to supply the missing Vitamin. A large quantity of peanut butter, jams, and jellies donated by the Beech-nut Company, is also a necessary adjunct.

In their spare moments—which will be happy moments—the men can play the piano, for there will be two in the camp at Bay of Whales, one of them an electric player, with a large number of rolls and sheet music. Or they can play whichever one they choose of the six guitars, 15 harmonicas, 12 ukeleles

(one of the crew of the *City of New York* is Ukelele Dick, retired from the United States Navy), or the two xylophones, taken along in case hands should be too cold to play any other instrument. Music is the life of every party, even near the South Pole.

When the four men detailed to handle reports, transcribe technical data, file daily findings and check the expedition's supplies, and others of the party, grow tired of work in the office building, which is to be 12 feet wide by 15 feet long and is now in the hold of the *Eleanor Bolling*, and of their work elsewhere, they can play quoits,

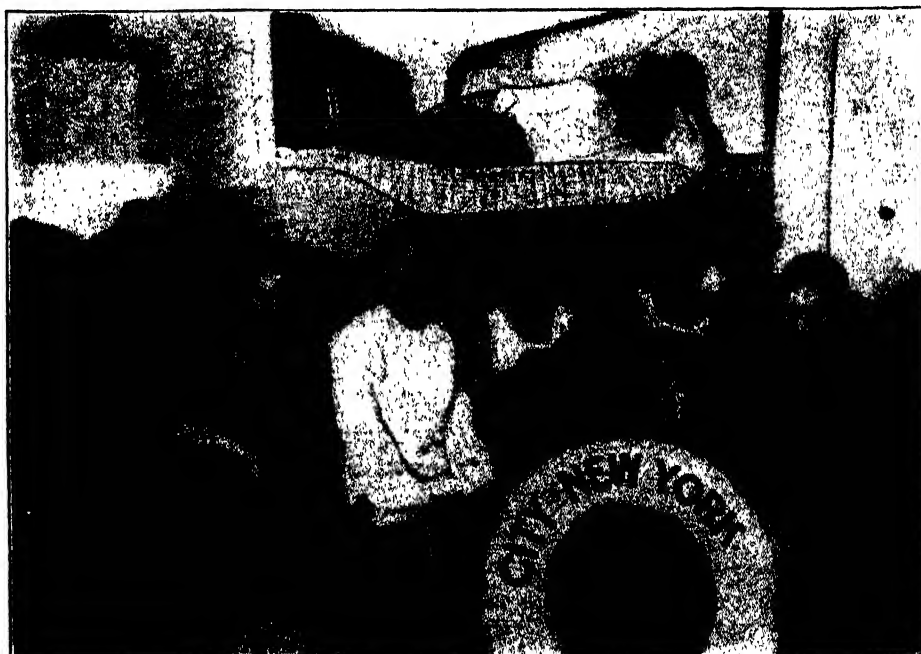
chess, checkers, baseball, or can box.

The expedition has been supplied with 20,000 sheets of a 100 percent rag paper of absolute permanence, and 40,000 sheets of a lower grade paper of lighter texture for carbon copies. This stock of paper was procured with the thought that records kept on the typewriter at the base camp will be in triplicate.

Scott, Amundsen, and Mawson, who spent some time in Antarctica, took only a few precious books with them. Commander Byrd, with that object in mind which prompted him to include pianos and xylophones and boxing gloves in the supplies, has assembled an extensive library for his associates.

THE actual selection of the books was left to Prof. Lawrence M. Gould, of the University of Michigan, a geologist with the expedition. He has tried to please everyone—scientists, shellbacks and even the Boy Scout! The books embrace science, fiction, poetry, philosophy and history, and number 2000, half of them the gift of David T. Layman, an attorney of New York City, the others purchased.

Fifty volumes of humor will make the quarters ring with laughter; six Zane Grey thrillers will fill the air with the aroma of the sage brush; and four Rex Beach novels will recall Alaska. Jules Verne's "Twenty Thousand Leagues Under the Sea" will remind the explorers that nothing in this world is impossible, and "The Vicar of Wakefield" by Oliver Goldsmith, will take the reader back to school days. Scott, Conrad, Pierre Loti, Joseph Lincoln, Romain Rolland,



THE LIFE OF THE PARTY

Far-sighted Commander Byrd believes in keeping up the morale of the personnel and, accordingly, included in his equipment musical instruments, books, games, and above all, good mattresses

Robert Louis Stevenson, Swift, and Mary Roberts Rinehart—all will be there.

Men who like to speculate while smoking will enjoy Nietzsche's "Thus Spake Zarathustra" and Santayana's "Essays," while those who know nothing of the long and interesting history of philosophy will learn the story from Will Durant's "Outline of Philosophy."

The continent wearing the South Pole in its button hole has been termed the "home of the blizzard" by Mawson, because most of the time the man in the open has to lean upon the wind at angles of 30 degrees to 45 degrees and even more—a wind that is seldom weaker than a hurricane. During the long winter months when nothing much can be done outside and the sun does not shine, there will be games for everyone to play, and books to read. Adventurers looking for the ghosts of Sherlock Holmes and Lupin, may see them when the wind howls in this most desolate region of the world.

SO that the explorers may protect themselves when they have to face this freezing wind for every day some must go out to take meteorologic readings, and so forth—100 pounds of odorless lanoline are included in the stores. Hands and faces will be smeared with this just as swimmers smear their bodies before entering the water for a long swim. Odorless lanoline was chosen because if it had a sheep's-wool smell, it would be very unpleasant.

When Commander Byrd bought the 47-year-old *City of New York*, (a stout little ship formerly called the *Samson*) he found her original supply of medi-

cine aboard! This would never do! So he told Dr. Francis Coman, of Johns Hopkins University, the Chief Medical Officer of the expedition, to assume the responsibility of providing, in advance, a stock of medical stores to cope with the almost unknown requirements of the party over a period of at least 18 months.

A single omission—an oversight in packing—might result in the death of one or a dozen members of the expedition, because once New Zealand is left behind, the last possibility of replenishment fades.

So Doctor Coman, with the cooperation of Dr. John F. Anderson, formerly Director of the Hygienic Laboratories, United States Public Health Service, and now Director of the Squibb Biological Laboratories at New Brunswick, New Jersey, put on his thinking cap and went to work.



AND CHICKENS!

Lieut. Comdr. Melville taking the temperature of frozen chickens before loading them



THEY CAN HAVE TOAST

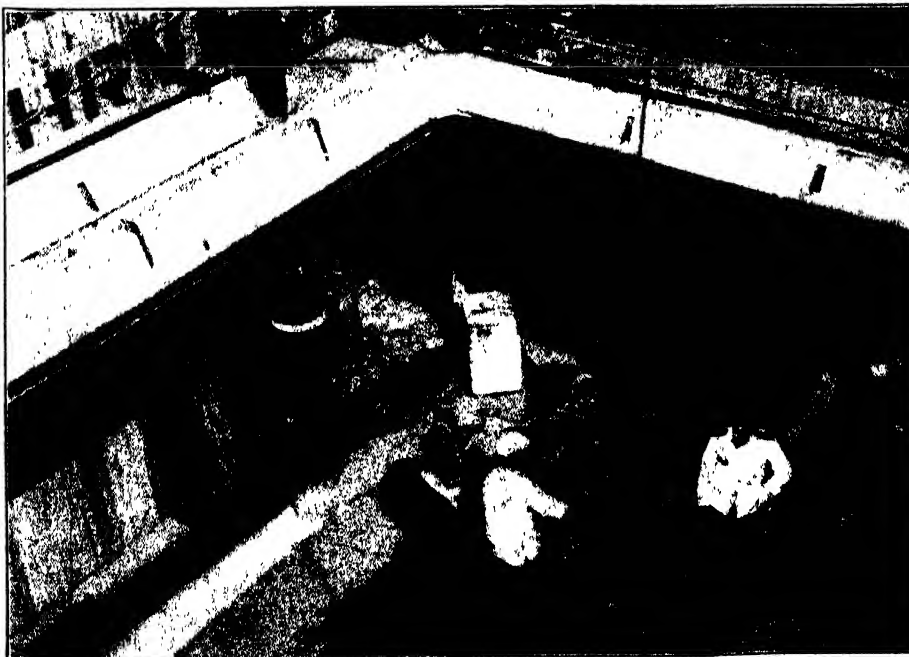
At any rate, here is the butter being loaded into the refrigerator of the supply ship

The two men assembled a stock of medical stores which, from the viewpoint of therapeutic excellence and completeness, has never been equaled by that of any other similar undertaking, capable of coping with everything from a scratch to the debilitating effects of a want of sunshine.

In assembling the supplies for the "sick-bay" of the mother ship and the "drug store" of the camp at the Bay of Whales, many factors were taken into consideration, and not the least of these was the possibility of running into natives in isolated villages who might be ill and direly in need of medical attention. From beginning to end, the expedition has been planned along humanitarian lines.

AT the time of departure from New York city, every member of the party will have been immunized against typhoid and small-pox. Additional vaccine is in the medicine chest for emergencies, and 200 packages of tetanus antitoxin are at the doctors' finger tips to immunize every cut, immediately. There are several hundred packages of diphtheria antitoxin in the locker, as well as Solargentum and Novargentum, germicidals, and cod-liver oil, castor oil, epsom salts, and—last but far from least—corn collodion for the comfort of the heavily shod feet of the explorers.

A large supply of ether (450 pounds, enough for 1300 operations) has been included for anesthesia. It is more than is anticipated will be used for the personnel, but the leaders of the expedition feel certain that at some time or other, in their long stay in the Antarctic region, they will run across numerous cases whose suffering can be relieved by an operation. Every aid known to medical science will be rendered all who may be taken sick.



VITAMINS FOR THE PERSONNEL

Calf's livers, previously frozen and packed in 10-pound tins, being placed in the ice-chamber of the Port Hunter. Commander Byrd wanted to be sure no one suffered a vitamin deficiency

Did Old Stone Age Man Inhabit Ireland?

*New Evidence, Adding a Chapter to Irish Pre-history,
Is Hotly Contested by Irish Anthropologists*

By J. REID MOIR

*Fellow of the Royal Anthropological Institute of Great Britain and Ireland
Member, L'Institut International D'Anthropologie
Vice-President, Suffolk Institute of Archeology and Natural History*

Drawings by the Author

AS readers of the SCIENTIFIC AMERICAN are well aware, there is at present considerable activity among archeologists in tracing out ancient man's history in England. It is now becoming generally recognized that human beings were in existence in East Anglia so long ago as Pliocene times, while during the warm interludes of the Great Ice Age which was regarded hitherto as one and indivisible, it is now known that Paleolithic man inhabited the country.

The recognition of these facts is resulting in a very drastic change in our view as to the antiquity and dispersion of the Paleolithic peoples, and while at one time, these were supposed to have lived in southeastern England in post-glacial times, about 100,000 years ago, we know now that the makers of the paleoliths roamed far and wide over the country in inter-glacial times and that the earliest of them existed perhaps 500,000 years in the past.

BUT although this is the case, it was with considerable surprise that scientific people received the announcement, made towards the close of 1927, that definite traces of Lower Paleolithic man had been found upon the coast of Sligo in northwest Ireland. There are, in fact, few places to which the average archeologist would be least likely to turn in search of such traces than to this part of Ireland, for it has been

taught for many years that during the whole of the period during which Paleolithic man lived in southern England, most of Ireland, especially the northern part, was covered by an immense ice sheet which prevented the existence of man in that area.

It is, however, of interest to note that apart from the evidence to be set forth in this article, there have been found at various places in Ireland, supposedly covered by the above mentioned ice sheet, the fossil bones of extinct animals such as were associated with Paleolithic man in England. Thus it is clear that the ancient fauna reached Ireland by land routes now submerged beneath the Irish Sea, and it is only reasonable to suppose that where the animals could go man could follow. The fossil bones were found in deposits of unquestioned antiquity, but it is to be regretted that at the time of their discovery no search was made for the stone implements likely to be associated with them.

During the summer of last year, my friend Mr. J. P. T. Burchell, a very keen and thorough archeologist, was spending a holiday upon the Irish coast, and while there he found at various sites a series of implements made of limestone, to which he quickly drew my attention. The place where he first found some of these specimens is at Coney Island off the Sligo coast, where, upon the shore, there were

recovered a number of artifacts in a somewhat rolled condition. From Figure 1, a very good idea can be formed of the wild beauty of the Sligo coast with its hard limestone rock fretted by the sea, and covered a little inland by deposits of glacial boulder clay and other accumulations.

When I examined the Coney Island specimens I at once recognized their human origin and the fact that they compared in their forms and flaking with the implements and flakes of known early Mousterian date. But, as the artifacts had been found lying upon the open shore, and therefore not assignable to any definite geological age, I urged Mr. Burchell to search for similar specimens elsewhere where the necessary conditions would be fulfilled.

IN the course of these researches he came upon a remarkable site upon the mainland at Rosses Point, where under a mass of rocks were found over 100 unrolled limestone implements and flakes of the same type previously discovered on Coney Island. The Rosses Point site is shown in Figure 2 and gives a very good idea of the blocks of limestone beneath which, and lying upon the basal platform of rock, the artifacts were recovered.

If an examination is made of Figure 2, it will be seen that facing the observer is a low wall of limestone *in situ*. The discovery of a large series of



THE WILD SLIGO COAST AT BALLYCONNELL

Figure 1: The hard limestone rocks are perpetually washed by seas that roll in from the Atlantic. High up on the right

is a deposit or cap of glacial boulder clay in which two of the artifacts described in the article were recovered



ROCK SHELTER SITE

Figure 2: Over 100 implements were found under the blocks in the foreground

implements made in the early Mousterian manner, under the large blocks in the foreground, suggested to Mr. Burchell's mind, as it would to most archeologists, that here at one time a rock shelter had existed which in the course of ages had collapsed. The wall of limestone seen in the photograph was supposed to have formed one side of this shelter, the other side of which has long since disappeared. Further, as the limestone in the area is covered in places by boulder clay, it is regarded as possible that the deposition of this material by ice, brought about the collapse of the roof of the shelter.

IT must, of course, be remembered that the site is reached by the sea at exceptionally high tides, and a certain number of the blocks now seen lying there have been moved to their present position by marine action. But the presence of undoubted implements of man in such a position, makes it necessary to postulate the existence there at one time of a shelter of some kind, comparable, possibly, with that shown in Figure 3, which is to be seen not far away from the Rosses Point site but farther to the south.

When a study is made of the instruments from Rosses Point it becomes abundantly clear that these are of early Mousterian forms, and made upon the general plan in vogue at that period.

The material used was the limestone so abundant in the area under discussion, and this rock which is so well jointed, as the photograph shows, was broken up into convenient "steaks," and by very skilful flaking made into rough hand axes, *racloirs*, *pointes*, and scrapers. Two *racloirs* or side-scrapers are here illustrated (Figures 4 and 5). A large, pointed hand-axe is shown in Figure 6.

These specimens, especially the *racloirs*, are of definite Mousterian type such as have been found at the station of this epoch at High Lodge, Suffolk, England, and at the rock shelter of *le Moustier* in France. Also during recent excavations in a cave at Monaco,

in the latter country, a series of implements has been found in the oldest layer which are made of limestone and bear a striking resemblance to many of the Sligo specimens. The Monaco artifacts are believed to be of the most ancient Mousterian culture, and thus support the interpretation placed upon those from Sligo.

Although the discovery at Rosses Point, while making it necessary to postulate great topographical changes since Mousterian times, seems to indicate that here was a place where the people of this epoch made their characteristic implements, yet these specimens were not found associated with a deposit of cave-earth and the bones of extinct animals such as are usually discovered in ancient paleolithic strata. Mr. Burchell accordingly made diligent search for further limestone implements in deposits of undoubted antiquity in the immediate neighborhood, and at Ballyconnel (Figure 1) was so fortunate as to find embedded in glacial boulder clay at a depth of 39 feet from the surface, two specimens which are of very real importance. In the first place, the age of these artifacts cannot be questioned and one of them (Figure 7) is a key-piece to the whole industry. It is a large "steak" of limestone and is a product in the first stage in the breaking up of the raw material. Unless its discovery had been made, the initial stage in the flaking process could only have been surmised. The other boulder clay specimen is a large flake made into



AN EXISTING ANALOGY

Figure 3: This rock shelter suggests the former shape of the one shown in Figure 2

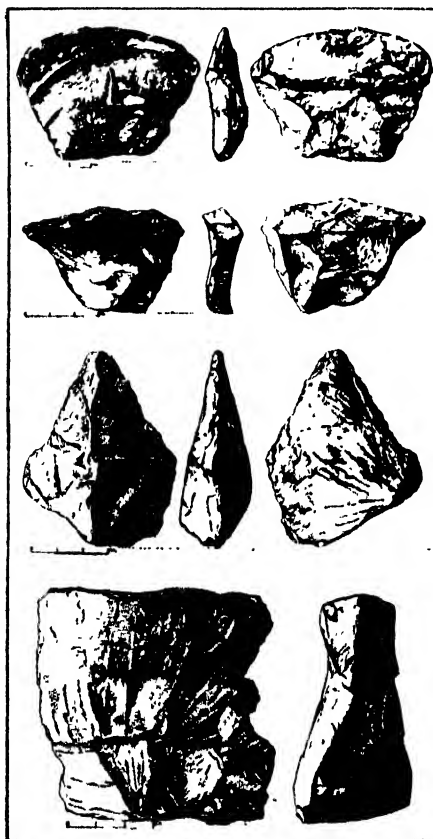
a hollow scraper exhibiting the same technique as those found at Coney Island or at Rosses Point.

It is perhaps needless to say that Mr. Burchell's discovery and the interpretation he has placed upon it have already been hotly challenged by certain Irish archeologists and geologists, among whom are numbered Professor Macalister, Dr. Charlesworth and others. They deny upon geological grounds the possibility of the Rosses Point site ever having been a rock shelter, and claim that it cannot, owing to the inroads of the sea, be more than 100 years old.

FURTHER, they state that the limestone specimens are not implements at all, but merely the result of rocks colliding with each other owing to the force of the waves, while the artifacts found in boulder clay are also regarded to be the product of some natural but unspecified agency.

Although I consider, in view of the types of implements found, that the geological conclusions of Mr. Burchell's opponents are unsound, they are nevertheless arguable and as such must and doubtless will be met. But the claim that the limestone specimens are the result of wave action, I consider preposterous and entirely unfounded. In reaching this conclusion I am relying upon an extensive observation of the effects of wave action in flaking stones and on a searching examination of all the specimens collected by Mr. Burchell, but readers of the SCIENTIFIC AMERICAN will be able by an examination of the implements here figured to come to their own conclusions as to which view is the more probably correct.

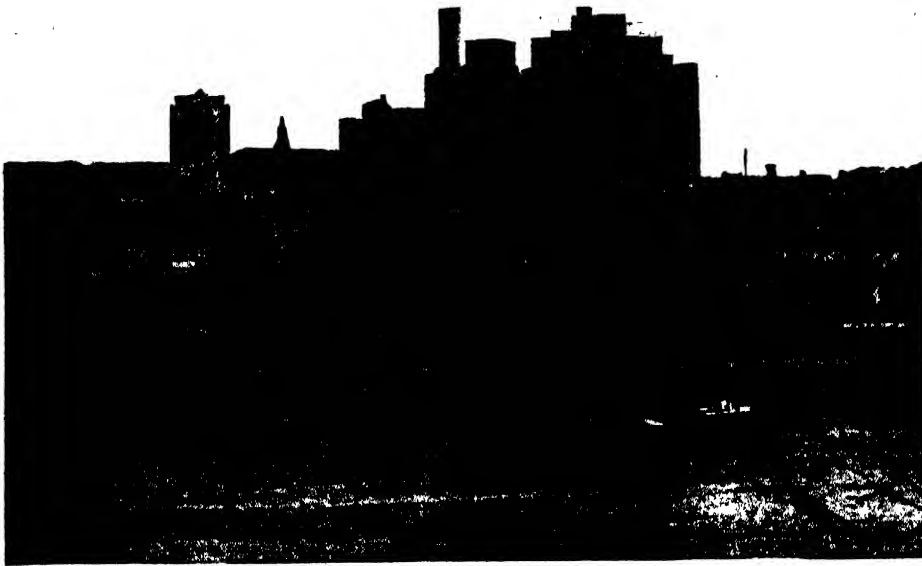
It is, of course, only right and proper that a discovery of such wide significance as that made by Mr. Burchell should be subjected to very drastic criticism before being accepted. This process is now going on, but it is my belief that he will be proved to be in the right and to have opened up a new chapter of ancient man's history in Ireland.



By Permission of Nature

THE ARTIFACTS

Top to bottom: Figures 4, 5, 6 and 7, respectively, referred to in the article



THE MEDICAL CENTER IN NEW YORK CITY

On the escarpment overlooking the Hudson is the great Medical Center, a consolidation of eleven hospitals, medical schools, and allied institutions. The group is harmonious architecturally.



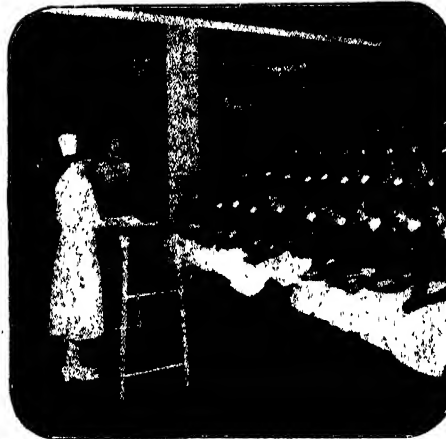
MAIN ENTRANCE

Over the entrance shown here are the words: "For of the Most High Cometh Healing"



INFORMATION DESK

No, this is not a hotel office, but is the dignified entrance to the private pavilion



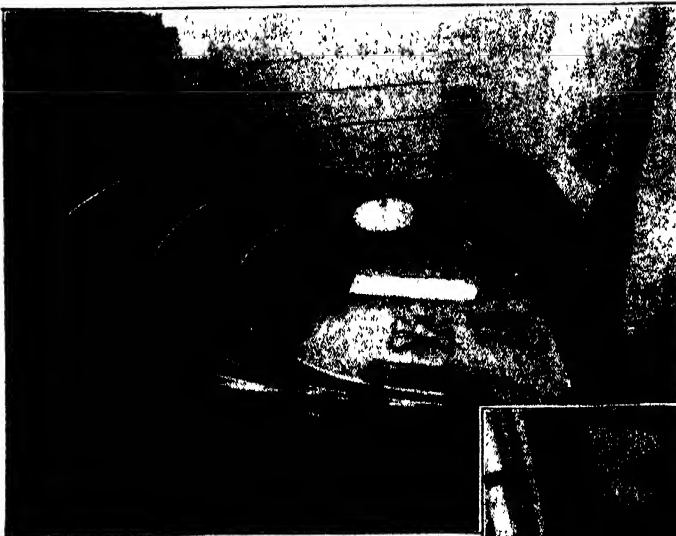
NURSES IN THE MAKING

A class in nursing is listening to a lecture. There is also a complete instruction ward



INDIVIDUAL REFRIGERATORS

The private patients have individual refrigerators to cool drinks and delicacies



THE OPERATING THEATER

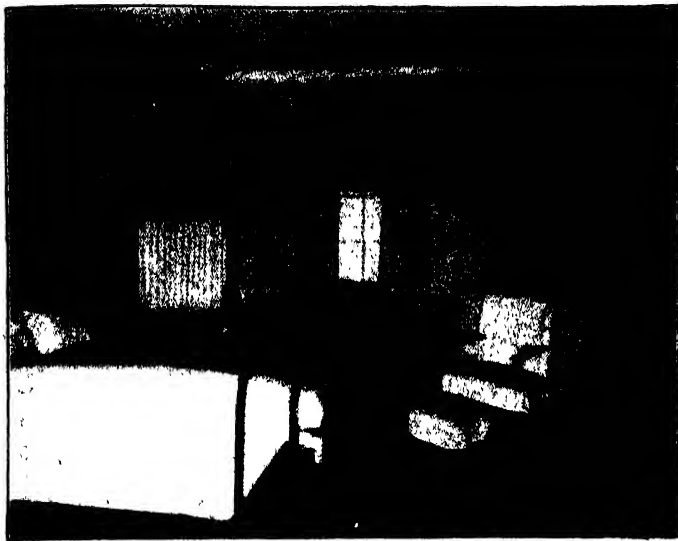
The Andrew J. McCash operating theater extends through two stories and affords ample accommodation for 249 students. To economize space and give a better view of operation, saddles like those on bicycles are provided. The glaring white is toned to light green and the lower part of the amphitheatre is lined with green tile. Every convenience known to science is provided



ONE OF THE OPERATING ROOMS

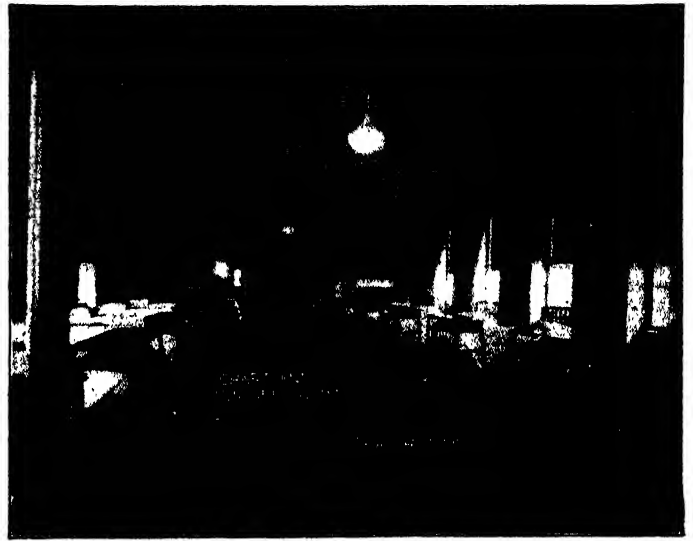
Like the operating theater, the operating rooms are lined with dark green tile, and every effort is made not to dishearten the patient. The operating rooms extend through two stories, and in the mezzanine there is accommodation for a few students who sit on saddles. A glass screen, see illustration at the left, prevents objects falling to the operating room proper below





NO KNOCKING RADIATORS

The hot water system of heating is in use so that there are no knocking radiators. The room, with decorations, does not suggest a hospital



ONE OF THE WARDS

Efficiency in hospital planning is exemplified in the wards. The interesting features are clearly shown and labeled in this illustration

Co-operation Extends Hospital's Scope

Massive Skyscraper Houses Consolidated Institutions

NEW YORK has witnessed in the last three years a significant development in co-operation—the establishment of a Medical Center wherein a general hospital, various specialty hospitals, schools of medicine, dentistry, nursing, and others, together with research laboratories, may all co-operate as a single unit with a three-fold aim of research, medical education, and care of the sick. The impressive group of buildings which rise above the Hudson River from West 164th to West 168th

Street occupies the site of an old 20-acre ball ground where memorable games were played.

Some idea of the size of the main building may be gained when it is stated that its 22 stories house the Presbyterian Hospital, the College of Physicians and Surgeons, the School of Dental and Oral Surgery, Sloane Hospital for Women, Squire Urological Clinic, Harkness Pavilion, the Babies' Hospital, Vanderbilt Clinic, and a power plant. Some of these institutions are housed in wings which do not attain the full height.

WHILE an attempt has been made to take the "H" out of hospital, scientific cleanliness is never forgotten and every room in all the structures is immaculate. In the Harkness Pavilion for private patients the entrance lobby is exactly like that of a hotel. The private rooms are very cheerful and friends or relatives can secure accommodations on the same floor and can have meals à la carte or in a cafeteria. In Maxwell Hall we have the last word in quarters for the students, who in three years become full fledged nurses. Every young woman has a room to herself and the dining room has small tables for groups. There is a swimming pool and a delightful roof garden.



OUT ON THE TERRACE

There is one floor given over to convalescents where there is a music room, a gymnasium, lounges and terraces

In the Presbyterian Hospital there are 800 beds in wards holding 12 patients each, and single rooms which can be secured by those who cannot afford the prices charged private patients who must help pay to keep up this enormously expensive institution. The building is heated with hot water so there is no hammering of the pipes to add to the misery of sickness. If you are a private patient you can have your own personal refrigerator.

Of course an operating room is not a very cheerful place at best, but you can take off the glare by dark green tile and the knives and other unmentionable tools of the surgeon can be housed in inconspicuous cabinets set in the wall. The laboratories, and wash rooms for the surgeons and nurses are all equipped in the most modern manner. In the maternity hospital the nurseries with their little cribs always strike a responsive chord in the visitor's breast.

The latest estimate of the cost of the structures and equipment is over 20,000,000 dollars.



THE NURSERY

Here the babies occupy little cots while glass screens serve to keep out drafts

Inventions For the Home



HYDRAULIC DRAIN PUMP

Clogged drain pipes may be quickly and easily cleared by means of this force pump which utilizes the force of water from the faucet through a short length of hose.—*Albert G. Burns, 1924, Broadway, Oakland, California.*



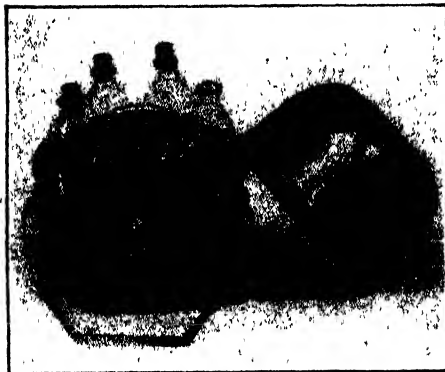
COOKERY PARCHMENT

A new paper that has been developed for use in cooking to preserve all the natural flavors of foods. The prepared food is tied in a square of the paper, cooked, and then turned out ready for serving.—*The Paterson Parchment Paper Co., Passaic, N. J.*



SMOKELESS BROILER

Directly beneath the grill of this broiler there is an inverted cone through the central hole of which the melted fats pour into the reservoir beneath.—*American Banking Machine Corporation, Saginaw, Mich.*



BABY BOTTLE KIT

Designed by a famous baby specialist, this kit enables the mother to prepare six feedings at once. Ice may be packed around the bottles.—*Therma Products Co., Toledo, Ohio*

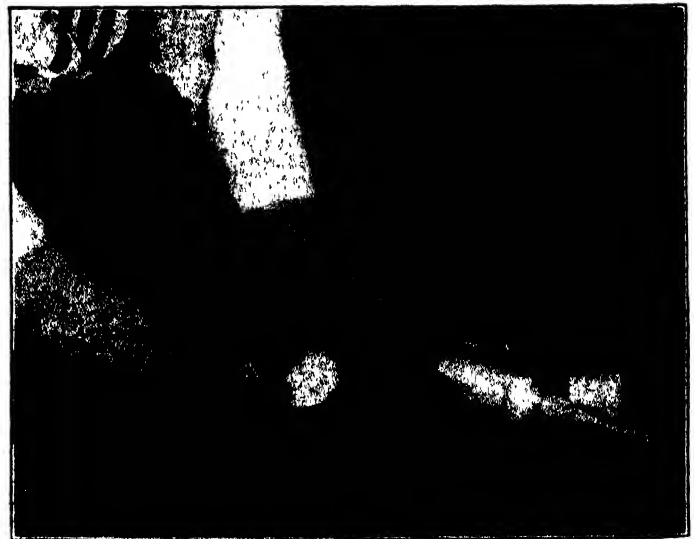
TELEPHONE-DESK

A combination telephone cabinet and desk that is attractive and should be very useful. The bell box is contained in the box at right of desk.—*Wm. Cameron Co., Builder's Building Exhibit, Wacker Drive, Chicago*

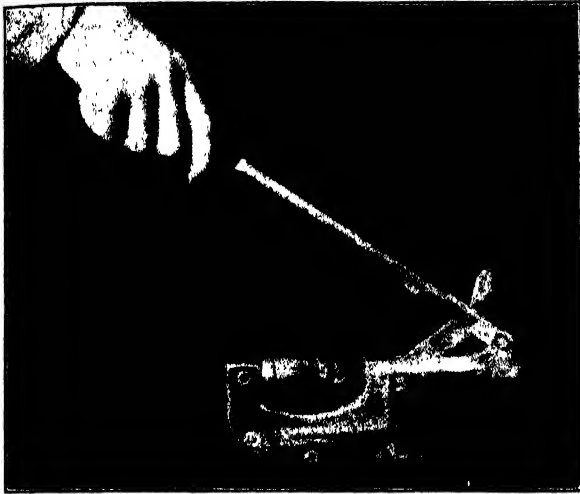


ICELESS BEVERAGE SHAKER AND ICELESS MASSAGE CONE

At the left is a shaker and at the right is a complexion cone for giving a chilled facial massage, both of which depend for their low temperatures upon the interaction of chemicals and water. The freezing mixture consists of two powders which, when mixed within the devices with a small amount of water, lower the temperature below that of



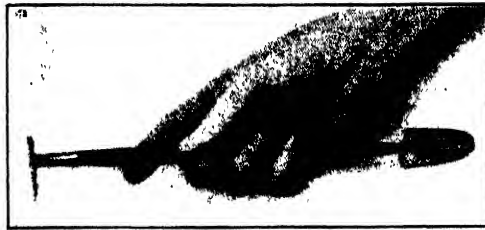
natural ice. In the shaker there is nothing to dilute the drink, since the mixture is inserted in the shell that surrounds the drink container. The massage cone is used to give the benefits of an ice massage without the usual drip. Shaker is aluminum or nickel-silver; cone is silver-plated.—*Cooling Devices of America, Ltd., 8 East 36th St., New York*

**PECAN CRACKER**

This new nut cracker has been designed to be attached to a table. Its strong leverage makes possible the cracking of a pound of pecans in a few minutes.—*G. L. Smith, 720 Beacon St., Los Angeles*

PAPER SOAP AND TOWELS

Soap paper made of pure wood fiber and coconut oil soap, and towels of heavy absorbent paper, furnish a convenient combination for campers, tourists, and hikers. Each package contains soap and towels for 12 washings.—*Ray West Paper Company, Green Bay, Wisconsin*

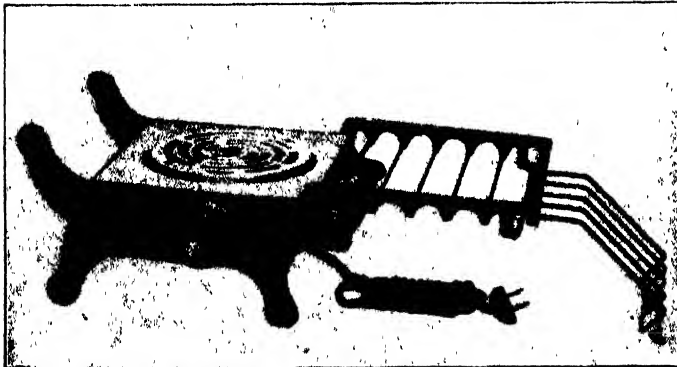
**A INDOOR GARDENER**

To replace the kitchen fork commonly used, this small combination rake and shovel will be found convenient for loosening the dirt around the roots of potted house plants.

—*J. L. Hudson Co., Household Utility Department, Detroit, Mich.*

**BAG HANGER TO PREVENT WRINKLES**

This simple device, arranged to be clamped within a bag, offers a new solution to an old problem of travelers. Dresses, skirts, or suits, hung over the hangers, may be folded in the bag to minimize wrinkling. Removal and hanging of garments at the end of a journey is facilitated as shown here.—*W. W. Winship and Sons, Inc., Utica, New York*

**AFOLDING ELECTRIC GRILLS**

The end "arms" of these two grills are arranged to act as legs when the grills are folded and stood up. The one at the left is a convenient bread toaster when stood upright. The grill shown at the right folds simply for convenience in putting it away on a shelf where the space may be limited.

—*Foldex Electric Heater Company, 1435 Franklin St., Detroit, Michigan*

CORNER BRUSH

This useful new brush is made in the form of a cup that fits over the top end of an ordinary broom handle. It gets into corners and is always handy.—*A. Z. Bose, Willits, Calif.*

LEMON JUICE EXTRACTOR

Since this new juice extractor is made of nicked wire, it will not break if dropped on the floor. It fits an ordinary drinking glass.—*F. W. Woolworth 5 and 10 Cent Stores and S. S. Kresge 5, 10 and 25 Cent Stores*



Inventions New and Interesting

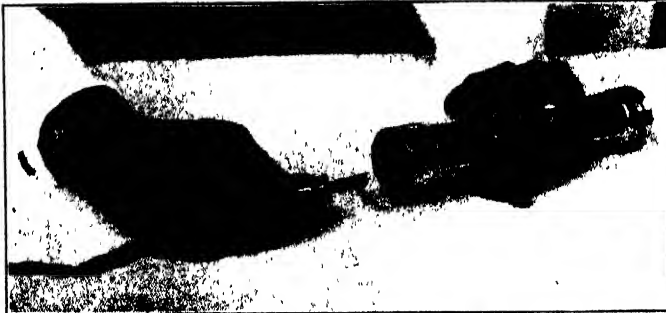


LAWN RAKE

This new fan-shaped rake has prongs of tempered, flexible steel that are rigid enough for raking and springy enough for sweeping. Grass is not torn up from the lawn and leaves do not clog the steel prongs.—*Master Mfg. Co., 138 Davis Ave., Dayton, Ohio*

ICELESS WATER COOLER

One of a number of styles of cabinets, utilizing Frigidaire, which have been designed to cool bottled water in offices and factories. The compact cooling unit is in the lower part of the cabinet.—*The Charles E. Hires Co., 206 South 24th St., Philadelphia, Penna.*



SINGLE SHOT BLASTER

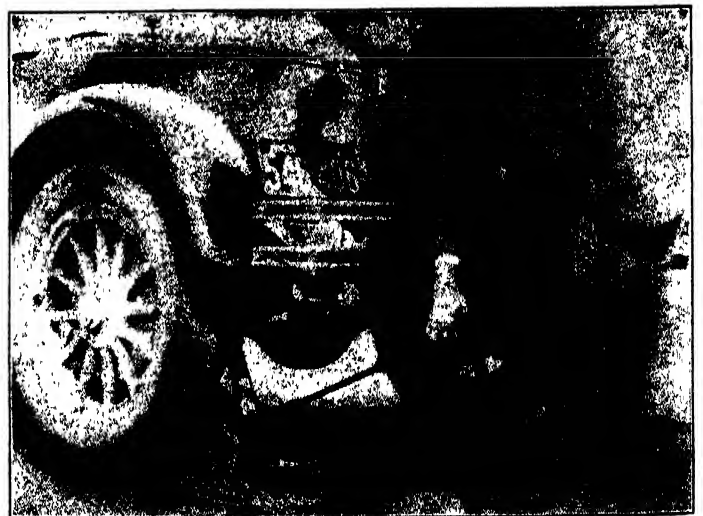
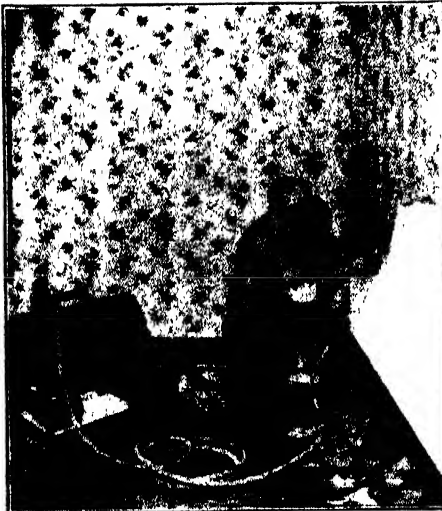
For use in mining or single shot blasting. Forcing the plug into the unit which looks like a flashlight, fires the shot. It contains three flashlight unit cells.—*National Carbon Co., Inc., New York and San Francisco*

WALL PAPER REMOVER

Steam, generated by an enclosed gas burner, penetrates and softens the paper. The outfit is portable and may be rapidly operated by one man.—*The Warner Mfg. Co., 529 S. Seventh St., Minneapolis, Minn.*

TEMPLATE CUTTER

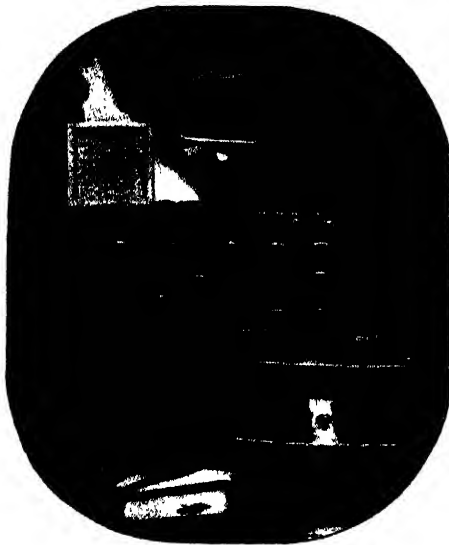
The powerful leverage of this cutter enables the workman to "nibble" off bites from the most difficult curves. With it, a few swift strokes will cut a template that otherwise would require laborious, uncertain drilling and much filing.—*National Machine Tool Co., 1536 Clark St., Racine, Wis.*



AUTOMOBILE JACK AND STABILIZER

The automobile jack shown in the two illustrations above is also a stabilizer since it "damps" the rebound when the car hits an obstruction in the road. Coming in sets of four, these new jacks are permanently attached to the car.

Each weighs eight and three quarters pounds and is attached to the spring between the axle and the end. In case of a puncture, the car may be raised quickly with a speed-wrench.—*Kant Fall Manufacturing Co., Sturgis, Michigan*



REFLECTOR TAIL LIGHT

The light from an approaching automobile warns its occupant when, on striking this device, it is reflected strongly. It uses no light of its own, but works on the simple principle of internal refraction.—*Catseye Reflecting Devices, Inc., Philadelphia, Pa.*



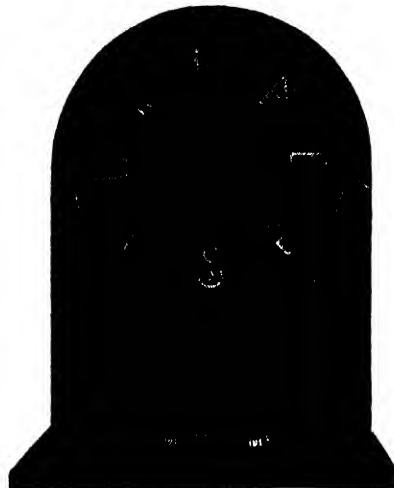
BREAKFAST SERVICE ▲ ➤

This three-tier tray facilitates the serving of light meals in the room of a club or hotel guest. The shelves, held together by a handle, hold food and all the dishes necessary. Its white cover also serves as a small table cloth.—*Serridor Company, 101 Park Ave., New York*



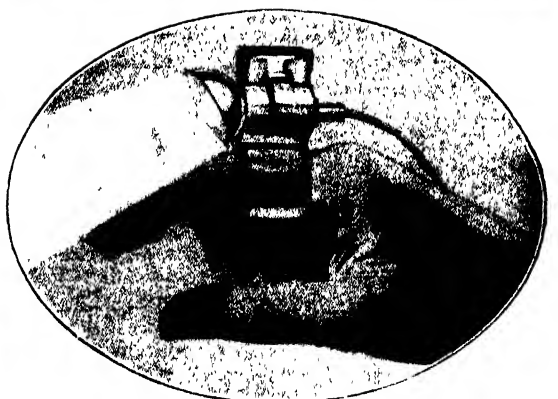
ASH RECEIVER

With this unique device, the regular ash can used by homes and large buildings, is placed on the elevator and lowered by a hand crank into the pit under the heater. The ashes are deposited by gravity in the can, ready for removal.—*The Ash Uplifter Co., Miller Building, Scranton, Penna.*



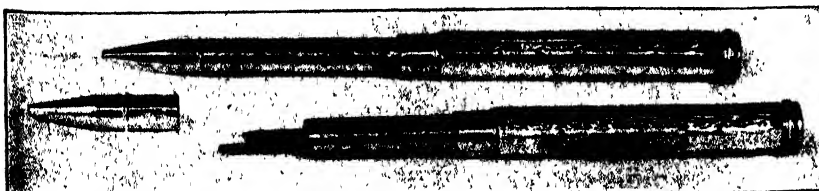
WIND INDICATORS ▲ ➤

The direction and velocity of wind foretells the weather. Above is shown the indicator which is installed far below the roof on which the instruments at the right are installed. The vane swings with the wind and a light flashes behind the proper letter on the indicator dial. In the center of the dial is a light which flashes the number of times a minute to correspond to the miles-per-hour wind speed shown by the anemometer.—*Charles E. Lord, 24 Milk St., Boston, Mass*



FINGER LAMP

Many uses will be found for this convenient lamp which gives light where it is most needed but leaves both hands free.—*Digit Mfg. Company, 272 Lafayette St., New York*



FOUR-COLOR MAGAZINE PENCIL

Pencil leads of four different colors, any one of which is ready for instant use, make this pencil valuable for checking work. The two ends telescope together. In order to write, the two parts are drawn apart slightly and turned until the proper color shows. When pushed together again, that color lead projects.—*Educational Exhibition Company, Providence, R. I.*

A Review of the Newest Developments in Science, Industry and Engineering

This cabbage is one product of a series of experiments that show that controlled temperature has an important effect on crops such as cabbage or beets that normally require two years to complete the cycle of fruit and seed. Vegetative growth continues so long as the plant is

quires only a two-month rest period in storage at 35 degrees to 40 degrees, Fahrenheit, after which the plants can be transplanted to a greenhouse for seed production. In this manner the two-year cycle can be compressed into one year. This method is particularly desirable for growing the first and second generation seed of any cross or selection.

Experiments on annual plants by W. W. Garner and H. A. Allard, of the United States Department of Agriculture, proved the importance of length of day in the maturing of annual crops. In the case of the cabbage, Mr. Miller has found that increasing the amount of light had no effect, but temperature appears to be a controlling factor of great importance.—*Science Service.*

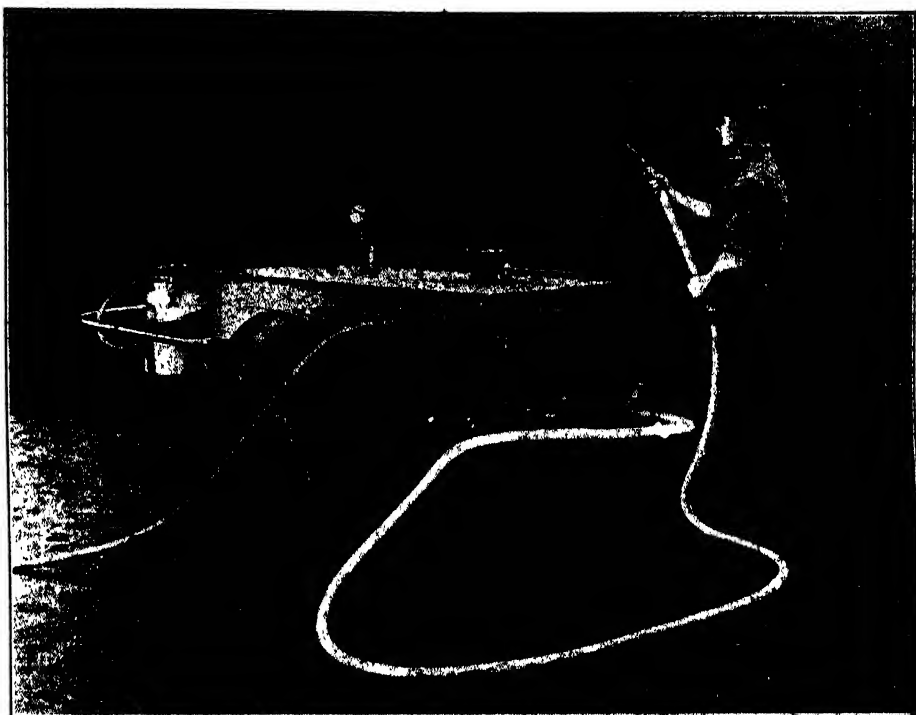
Bitumen Spray Gun

SPECIALLY designed for applying hot tar, asphalt, and other waterproofing or protective materials to concrete, water tanks and reservoirs, pipe lines, penstocks, et cetera, a new bitumen gun has been developed by the Quigley Furnace Specialties Company of New York City. It is an adaptation of, and similar to, the refractory gun which has been made by this company for years.

Compressed air is used in this gun to operate a piston which forces the liquid out. The air does not, however, come in contact with the material. The formation of the spray is mechanical and due only to the piston pressure. To operate the gun, 15 cubic feet of air a minute is said to be required.

For hot spraying, preheated material is put into the cylinder above the piston through a charge opening in the top of the machine. The temperature of the material in the gun is maintained at the proper point by a small self-contained kerosene burner, a large-scale thermometer being conveniently placed in view of the operator.

A special insulated metallic hose is used,



The compact, easily portable bitumen spray gun by means of which preheated liquids may be sprayed on concrete, water tanks and reservoirs, et cetera

The gun is completely inclosed in a steel housing mounted on wheels and is readily moved from place to place. It has a capacity of 15 gallons, or sufficient to cover about 400 square feet of surface with one filling.—*Power.*

be applied in industry, it will be of considerable commercial importance, it is believed.—*Science Service.*

A New Type of Concrete Reservoir

IN the plain of San-Eulalia, Province of Térue, Spain, a unique water reservoir has recently been built of concrete, reports *Le Genie Civil*. This region is characterized by an extremely dry climate, and in order to achieve better agricultural results, one of the local land-owners installed an irrigation system utilizing the flow of a well by means of a compound motor-pump delivering 2000 liters a minute. To facilitate the regular distribution of the irrigation water

Frozen Meat Seems Fresh

BITISH brains have been hard at work to make palatable the famous roast beef of England, that has to come in these degenerate days all the way from Australia or South America.

The freezing process necessary to carry the meat on its long journey dries up all the



Photographs courtesy Le Genie Civil.

Exterior view of the unique water reservoir that was recently built in Spain. This indicates clearly the manner in which the slightly arched sectors were supported by vertical ribs which rest on a concrete, 15-point star base



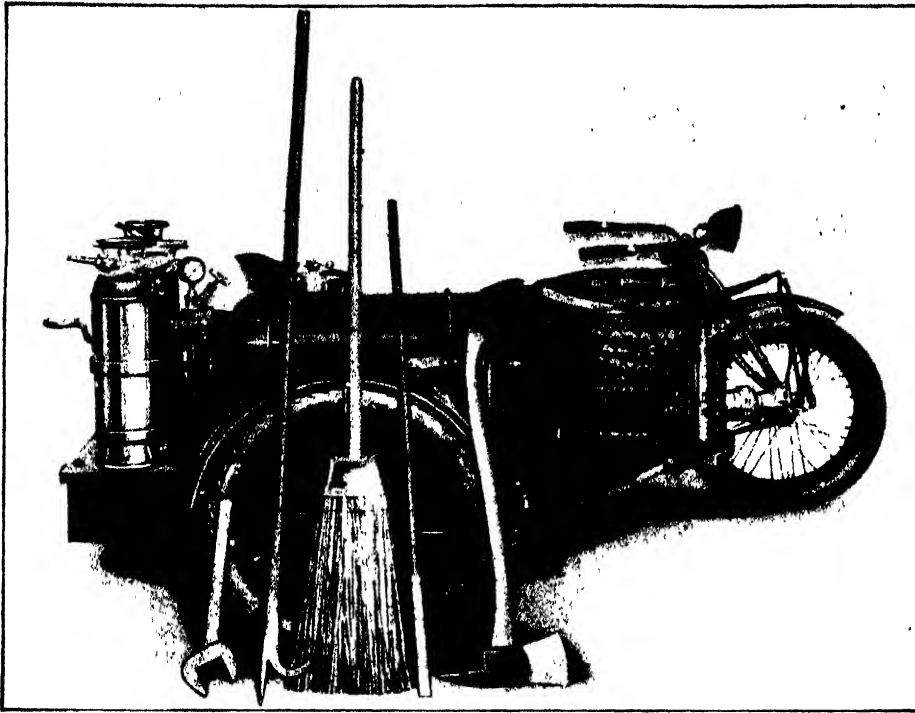
Interior view of the reservoir partly filled with water. The arch design and the gentle slope of the sides are readily apparent. The arches extend to a circular plaque at the base. Its capacity is 7580 cubic feet of water

and it is claimed that the machine will discharge the material any distance up to several hundred feet with a drop in temperature of not over three degrees for each 25-foot length. The discharge end of the nozzle can be turned at an angle in order to reach restricted spaces, and special nozzles are available for certain requirements that may come up in practice.

natural juices. It has been found, however, at the Low Temperature Research Station at Cambridge that when beef is frozen and then thawed very slowly, practically no fluid is lost. In one experiment, the time consumed in freezing and thawing took nearly 80 days, at the end of which the meat was hardly distinguishable from fresh. If this method can

at convenient times, it was necessary to construct a reservoir holding 700 cubic meters.

Since the funds available for this purpose were limited and the earth formation at this point was very poor—being inconsistent clay—the unique reservoir that was finally decided upon and built was thought to be the most feasible.



Due to the speed and mobility of this motorcycle fire-fighting auxiliary, it can easily precede heavier equipment in answering a fire alarm or fight small fires

The reservoir basin was built in the form of a wide open cone, the walls of which consist of 15 identical sectors, each lightly arched. The joint between each pair of adjacent sectors is supported by a rib resting on a base which forms a star with 15 points. The center of this base consists of a circular plaque which constitutes the bottom of the reservoir. By building the reservoir in this form, the difficulties offered by the ground formation were overcome and a surface of sufficient support was obtained.

The construction work on this project was accomplished in 50 days and the total estimated cost was 7500 pesetas. The designer was Juan Cordobes, highway and bridge engineer of T r el.

New Uses For Cadmium

IN spite of the relatively high price of cadmium, the metal is beginning to find a number of important applications, says the *Industrial Bulletin* of Arthur D. Little, Inc. It has recently been applied to the rust-proofing of locks, hardware, automobile parts, and wire products by a process which involves electroplating the cadmium thereon, and subsequently heating the plated articles for several hours, whereby the cadmium coating is alloyed with the metal of the plated article. A small proportion of cadmium is often alloyed with silver to make the latter more resistant to tarnish.

An especially promising application of cadmium appears to be in its addition to copper intended for wire-drawing. These alloys have a higher tensile strength and annealing temperature and greater resistance to abrasion than hard-drawn copper, and as only a small proportion of cadmium confers these benefits, its addition does not seriously reduce the electric conductivity of the wire.

Cadmium is also finding limited use in jewelry, as it gives green alloys with gold, and it is employed to some extent in fusible alloys. Its addition to aluminum is advantageous where the aluminum is to be used in the manufacture of aluminum

powder. The addition of cadmium in this instance improves the color and luster of the powder and makes it more resistant to atmospheric corrosion when used in paints or lacquers.

One of the latest uses reported for metallic cadmium is in the manufacture of tungsten electric light filaments. An alloy of 42 percent cadmium, 53 percent mercury, and 5 percent bismuth, is impregnated with tungsten powder. The mixture is made into wire by the extrusion process, and after passing through a die, is heated to drive off the alloy, and finished by heating in a vacuum to consolidate the tungsten.

According to *Engineering and Mining Journal*, production of metallic cadmium in the United States in 1927 amounted to 1,074,645 pounds, an increase of 38 percent over 1926, as reported by producers to the United States Bureau of Mines. During 1926 and 1927 its price remained at 60 cents a pound but recent increase in the demand for cadmium as a plating metal has caused the price to rise to 65 cents.

Fire-fighting Auxiliary

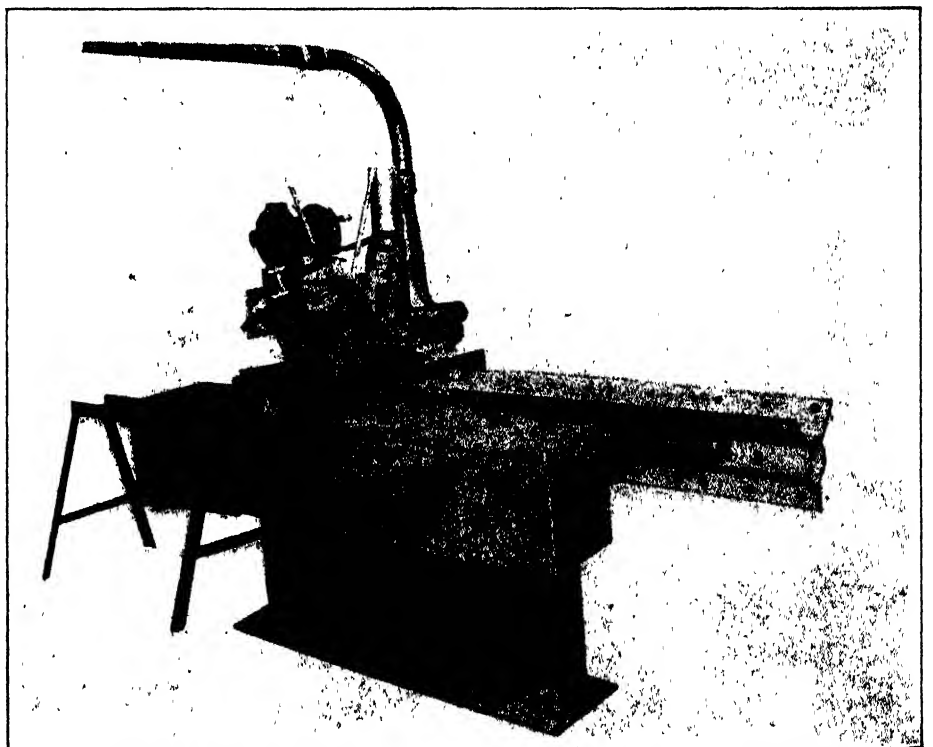
WHAT is perhaps the world's smallest efficient piece of motor-driven fire apparatus has been designed and is now being manufactured by the Indian Motorcycle Company of Springfield, Massachusetts. It consists of a motorcycle to which is attached a side-car chassis holding a complete set of fire-fighting equipment.

The equipment consists of a 25-gallon chemical tank, a two and one half gallon foam extinguisher, a two and one half gallon soda-and-acid extinguisher, (all of the fire department type), and four small extinguishers. Other pieces of equipment carried are: hydrant wrench, plaster hook, fire broom, crow-bar, fireman's axe, and 100 feet of chemical hose in a wire basket.

The entire equipment is only about eight feet long and four feet wide. Its speed is said to be about 65 miles an hour. Thus it should prove a valuable adjunct to airports where, in the event of a crash, quick action may be necessary in fighting the resulting fire. In cities throughout the country it is already being used as an auxiliary. Its speed and maneuverability enables it to reach a fire long before the heavier apparatus can arrive.

Details of New Welding Process

WHILE the Electronic Tornado welding process was mentioned in the *SCIENTIFIC AMERICAN Digest* in the April issue, this was in effect an advance notice, (Please turn to page 462)



The complete Electronic Tornado welding machine for welding oil derrick clamps. Note welding heads and electrode holders crossing each other at an angle. The process is said to be adaptable to many kinds of welding jobs

This grainless wood board can be cut out, punched, die cut and shaped!

Has a smooth, attractive surface on the face side and requires no paint for protection. Also takes any finish beautifully. Possesses uniform strength, highly resistive to moisture, very dense and tough. New uses discovered almost every week. Send for large free sample, and find out what you can do with Masonite Presdwood.



FOR STORE FIXTURES

If you are a manufacturer, an inventor or a mechanic of any kind, you will certainly want to know all about Masonite Presdwood, the *grainless* wood board of a thousand uses.

Presdwood has now been on the market over two years, and in scores of industries it has helped

to make good products better and cut down operating costs.

In fact, results prove that Presdwood is workable and adaptable almost beyond belief. It can be cut out. It can be die cut and punched. It will not crack or check. It will not split or splinter. It can be used on saw, planer, sander and shaper. It is highly resistive to moisture, it has uniform strength, it is very dense and tough. It has a smooth, attractive surface on the face side, requires no paint for protection, and takes any finish beautifully.

"A truly wonderful product," says practically everybody who has put it to the test. And note particularly that Presdwood contains no foreign substance of any kind, not even a chemical binder. It is simply wood torn apart and put together again—clean, fresh wood straight from the forest, and nothing else!

Astonishing range of uses

There actually seems to be no limit to the uses for Presdwood. We ourselves are astonished almost every week by some entirely new and unexpected demand for it.

Not only are thousands of feet of it going into the making of such things as table tops, breakfast nooks, store fixtures and signs, but it is being extensively used in the manufacture of toys, doll houses, fire screens, tension boards, bread boxes, clothes hampers, and dairy containers.

Bank vaults and telephone booths are lined with Presdwood. It is being widely used in building steam boats. It makes an ideal flooring for dance halls and park pavilions. It is becoming more and more popular for all kinds of paneling.



FOR PANELING

Cooling trays for hot castings, starch trays for candy factories, bedroom screens, invalid trays, incubators, dust arresters for journal boxes, bowling alleys, and shutters for Dutch Colonial Houses—all of these things are made of Presdwood.

Where especially fine, smooth work is required, there is nothing like Presdwood for concrete forms. Presdwood is used extensively in making movies. Not forgetting that the Chicago Art Institute has found this *grainless* all-wood board an excellent material for hacking and protecting rare works of art!

Try Presdwood yourself

Presdwood has scores of other uses, and new uses are being discovered week after week. Remember, too, that Presdwood is not only workable almost beyond belief, but that it positively will not damage tools.

Adaptable for any woodworking machinery, uniformly strong, and highly resistive to moisture, it can also be lacquered, painted, stained or varnished. And yet it requires no paint for protection.

Write for a large, free sample of Masonite Presdwood, and find out what it will do for you. It may be the very material for which you have long been looking. It may enable you to make a worthwhile improvement in your product, and at the same time lower your operating costs. Try Presdwood for yourself!

MASONITE CORPORATION

Sales Offices: Dept. 1611, 111 W. Washington St.
Chicago, Illinois

FOR PLAYHOUSES AND TOYS



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Mills: Laurel, Mississippi

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Made by the makers of
MASONITE STRUCTURAL INSULATION
200, 250, 300, 350

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Learning to Use Our Wings

This Department Will Keep Our Readers Informed of the Latest Facts About Airplanes and Airships

CONDUCTED BY ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York City

Developing Motion Pictures in the Air

THE development of motion pictures in the air so as to save time in their delivery to Broadway theaters is another airplane achievement. Competition in the delivery of motion pictures of the Republican National Convention at Kansas City

while flying over the Alleghany Mountains between Cleveland and Bellfonte. Fog brought the plane down for several hours in its 1200 mile journey, and for part of the route the weather was too bumpy for developing work. Nevertheless the films were delivered on Broadway many hours

danger that the pilot may jump and leave the passengers to their fate—although our devoted airmen are not likely to desert their charges in such fashion. Therefore pilots are not allowed to carry parachutes in passenger transportation.

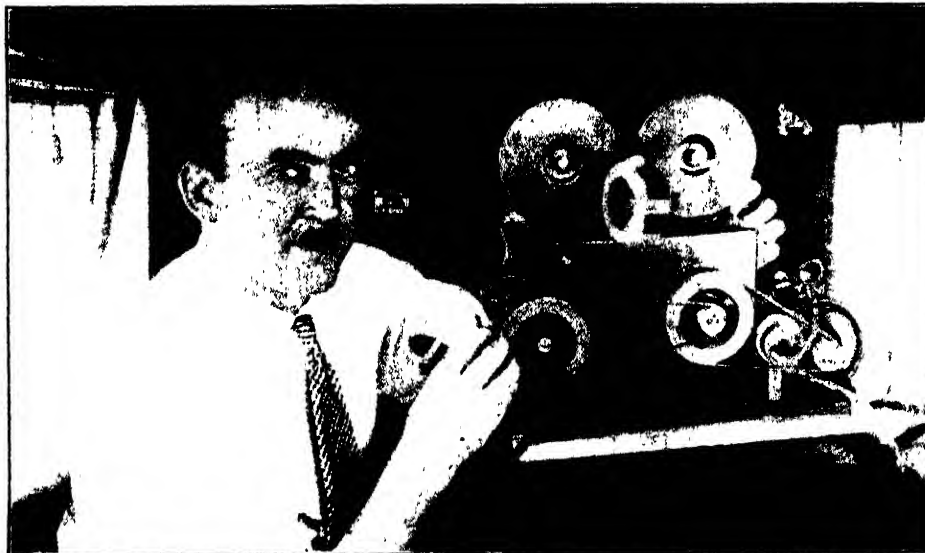
The question arises whether both pilot and passengers should be provided with 'chutes, which would be the counterparts of life belts at sea. Unfortunately very few passengers can be relied upon to jump at the crucial moment. In an enclosed cabin monoplane, the passengers would probably find it impossible to jump.

European practice is strongly against the use of parachutes for passengers, but both in Europe and in the United States a number of devices have been seriously considered to increase passenger safety via a jump through space. One suggestion is that the passenger cabin be connected to a parachute, which could be released by the pilot and sustain the cabin in safety while the rest of the plane hurtles through space. Another suggestion is that all passengers wear parachutes which will open automatically, and that at the will of the pilot all passengers would be launched through the floor into space. This idea does not seem particularly pleasing.

Perhaps the most attractive idea is that of a giant parachute which could sustain the entire plane in case of need.

This is the plan on which Major E. L. Hoffman of Wright Field is working. He has developed and is perfecting a giant parachute 84 feet in diameter. It is structurally a reproduction of the usual man-carrying type, having a pilot 'chute, vents in the dome and the same weight and quality of silk and the same type of shroud lines. It has more panels than the ordinary 'chute, namely 96, and more shrouds, namely 48.

Many tests have been performed with this giant 'chute. A 1600 pound bomb has been twice released from a bombing plane flying at an altitude of several thousand feet. One difficulty that developed in these tests is that the lift of the parachute was so great that it refused to deflate on striking the ground and carried the weight of 1600 pounds a great distance across the field before it could be halted. A positive



Henry Cuthbertson with part of the aerial "movie" finishing apparatus

was naturally very keen. The Ritchfield-Paramount News-Associated Press flying laboratory undertook the task of developing films in the air.

It was intended originally to use the Fokker-10, a large machine with ample space in its fourteen-passenger cabin. The Fokker was unavailable at the last moment and a five-passenger Ryan brougham, similar in design to the famous *Spirit of St. Louis*, had to be used instead.

The cabin behind the pilot's cockpit was converted into a dark room. The first problem was to procure developing tanks, drying racks and a printing machine that could be installed in the very small space available. A battery was installed to drive the printing-machine motor.

Negative titles were made in advance as it would have been impossible to set up type in the airplane, in addition to the other operations necessary. Since the program of the convention was known, these titles could be easily written ahead of the event itself.

The negative was developed on a spiral reel, then immersed in a hypo tank and finally washed enough to keep the film about two weeks. Racks which could be revolved inside the cabin were used to dry the negative, which ran about 100 feet in length. The windows were opened and the propeller wash of the plane practically blew the water off the film. The negative was then cut and the titles inserted. It was then ready for printing.

The major part of the work was done

ahead of all others which had been delivered by plane, but developed later on the ground

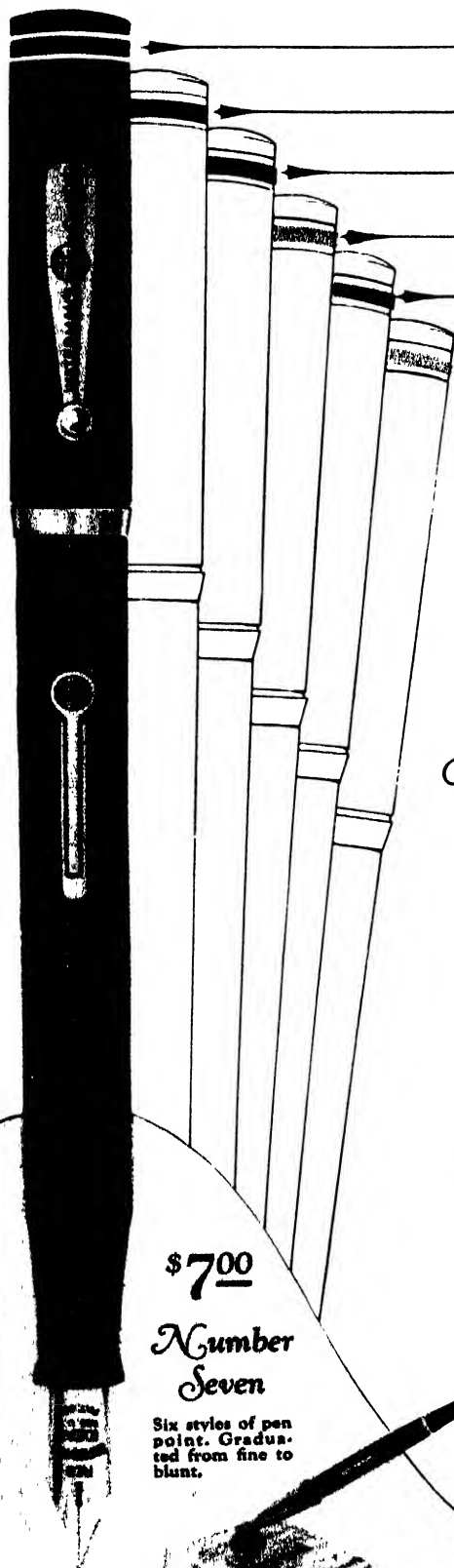
Parachutes for the Entire Plane

NO ARMY, Navy or air-mail pilot ever goes aloft without wearing a parachute. Jumping with the parachute has now become an accepted part of an airman's training, and after the first few jumps it becomes almost a matter of routine. Pilots sometimes purposely delay the pulling of the rip cord so as to get more of a thrill out of their jumps. In all commercial flying, where passengers are not carried, the parachute is of indisputable value.

Where passengers are carried on transportation lines, the matter is more complicated. If the pilot carries a parachute and the passengers do not, there is always the



The Ryan cabin plane that carried the portable picture developing equipment



Red

STANDARD—Suits most writers. A splendid correspondence point. Medium flexibility. For home and general use.

Green

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Yellow

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The Color Band Inlay on the Cap Identifies the Character of Every Pen Point

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The popular way today is to pick your pen point by color. Thousands by this simple method are now enjoying real writing comfort for the first time. Quickly and accurately, from six different styles, you select the pen point best suited to your way of writing. The perfectly balanced No. 7 stainless holder of Ripple Rubber, fitted with a personally selected point, assures permanent fountain pen satisfaction. Without further delay ask the nearest merchant to show you all six styles of No. 7.

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Number Seven

Six styles of pen point. Graduated from fine to blunt.

Desk Set No. 7167—Onyx base, green gold finished frame and name plate, 3 x 4 1/4; price \$18.00

Desk Set No. 6467—Black and gold marble oval base, 7 x 10; two pens; price \$30.00

Desk Set No. 6067—Onyx base, 2 1/4 x 2 1/4; price \$10.00

Desk pens may be had in all color holders and all styles of nibs

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The Reference Book That Fascinates

The Scientific American Annualog for 1929, the unique reference book, different in matter and manner from any other publication in the world (except the Annualogs that have preceded it) is now off the press.

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Here are a few of the things it covers:—

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Industrial Alcohol
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Celotex
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Fireproofing Wood
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Pearl Culture
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THESE MODELS

THE SPECIAL DELIVERY is a speedy and sturdy $\frac{3}{4}$ -ton truck, of 124-inch wheelbase, and admirably adapted for most any light-haul requirement.

THE SIX-SPEED SPECIAL is a 1-ton job with 6 speeds forward and 2 reverse. A speed for every need; power for every emergency.

Model S is a general-purpose truck for regular hauling and delivery of $1\frac{1}{4}$ -ton loads. Supplied with either 4 or 6-cylinder engine.

Model SF-34, 4-cylinder, and **Model SF-36**, 6-cylinder engine. Both of $1\frac{1}{4}$ -ton capacity.

Model SF-46, 2-ton capacity, with 6-cylinder engine and 4 forward speeds.

Models SD-44 and SD-46 (4 and 6-cylinder). Heavy-Duty Speed trucks, especially designed for dump and trailer work. Four-speed transmission and cantilever rear springs.

Always in the front rank in truck engineering, the International line of Speed Trucks is now offered with important improvements throughout, in design and construction.

Greater economy in operation, roomier bodies, new cabs, greater driving ease, fuel and air cleaners, longer and stronger frames. The same reliable spring suspension as before, and four-wheel brakes on every model! One of the examples of International advanced engineering is the Six-Speed Special—the only Heavy-Duty Speed Truck built with 6 speeds forward and 2 reverse.

Capacities range from $\frac{3}{4}$ ton to 2 tons, and all $1\frac{1}{4}$, $1\frac{1}{2}$ and 2-ton models are available with either 4 or 6-cylinder engine. There are bodies for every kind of work a truck must do, from economical excavation to delivery de luxe. There is speed for good going, plenty of power for bad, and sturdy stamina to stand up under every load. Trucks easy to ride and drive, easy to look at, easy to like!

And every International Speed Truck is all truck—not a rebuilt passenger car in the line. Every one of them is built for work—and famous for it. And they are better trucks now than ever!

In addition to the Speed Trucks, the International Line also includes Heavy-Duty trucks ranging from $2\frac{1}{2}$ -ton to 5-ton sizes, Motor Coaches, and McCormick-Deering Industrial Tractors. All are sold and serviced by 169 Company-owned branches throughout the United States and Canada, and dealers everywhere.

INTERNATIONAL HARVESTER COMPANY
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606 So. Michigan Ave. (INCORPORATED) Chicago, Ill.



release mechanism is being designed which will separate the parachute from the weight carried when the ground is struck. A quick deflation method also is possible.

In California, a plane parachute has actually been used to lower a "Jenny"

craft must be capable of alighting at say Curtiss Field, or the Newark Airport, and at the same time, in case of engine failure, must be able to take care of itself at sea. Depending on the mail load carried, weather conditions and other factors, it is hoped to

at Seattle, Washington, quite recently.

A Travel-Air OX-5 biplane was employed to snatch up a 35-pound pouch of air-mail matter. The equipment in the plane consisted of a drum on which was wound a steel trailing cable fitted at the end with a small steel ball. A safety spring in the drum allowed immediate unwinding of the cable if entangled with an object on the ground. On the ground the load to be picked up was held ready in a large metal trough, V-shaped, and with sides eight feet high to guide the steel ball.

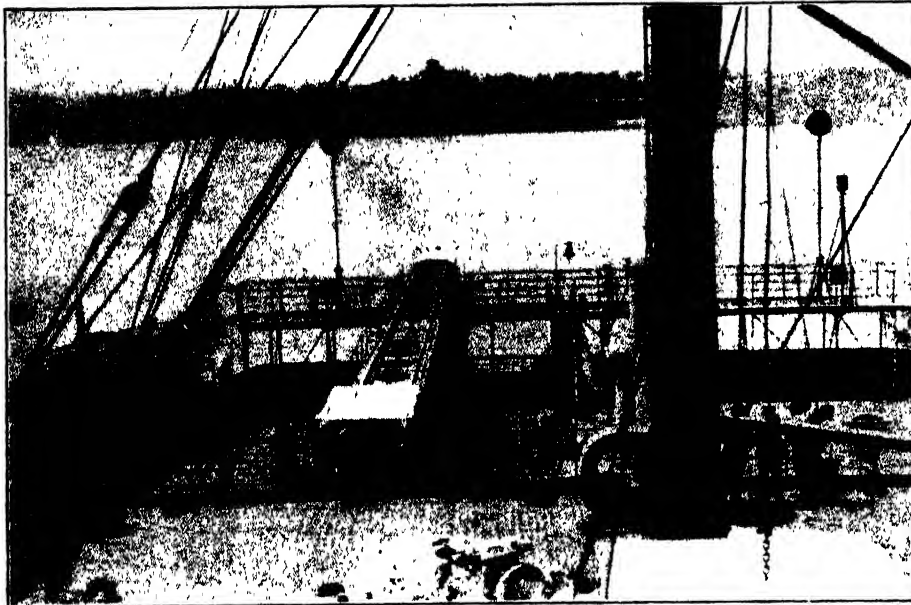
The unit was mounted on a turn-table so that it might face directly into the wind. The ball was dragged through a sand approach into this large slot until it reached a narrow slit and engaged an aluminum thimble. The thimble in turn was connected directly by a short piece of cable to the load. For large loads where inertia might create a serious problem, the load is to be hurled forward at a speed of 45 miles an hour by a spring trap that is released automatically when the ball engages the thimble.

Giant Seaplanes

ADVOCATES of the airship maintain that for transatlantic flying, the airship is far superior to the airplane because of its greater range and carrying capacity. Seaplane constructors in Germany challenge this assertion. They are of the opinion that very large seaplanes can be built, equipped with so many engines that the danger of power plant failure will disappear, and with hulls so large and sturdy that they can outlive the roughest seas.

The Rohrbach Company is building a series of eight three-engined flying boats of the Romar type, which are to be put in service between Germany and the Argentine. The Romar has three engines of 600 horsepower each and is one of the largest planes ever built.

(Please turn to page 467)



Catapult runway on the after deck of the *Ile de France*. This is designed for use with an amphibian plane, which is a necessity for the work to be done

plane, although with somewhat indifferent results. Major Hoffman is quite confident that he can perfect a reliable and simple parachute that will sustain the largest plane at need.

Catapulting Off a Liner

A GREAT many of our warships now carry fighting or observation planes on board, and catapult them from gun turrets which can be swung into the wind no matter what its direction. It has often been suggested that similar methods could be employed on board ocean liners to expedite the delivery of mail, and our readers will no doubt remember that Clarence D. Chamberlin, the transatlantic flier, has actually flown a plane off the *Leviathan*, making his get-away from an inclined platform and flying safely to land. Chamberlin used a Sperry Messenger, lightly loaded, and needed only a comparatively low speed and a short run to get safely into the air.

With a heavy mailplane, a simple runway, even though inclined, may not suffice. Accordingly, on the French liner *Ile de France*, a catapult has been installed. While the details available are scant, it is fairly clear that the catapult consists of a carriage moving on two rails, and pulled by a cable which is wound up by a compressed air motor. The runway will be 100 feet in length. Compressed air is no doubt being used because it can be made to furnish a great deal of power for a very short time, and can be made to exercise its full power at very short notice.

The catapult is placed on the after-deck and is in charge of Lieutenant Commander Demourgeot, who arrived here to study landing facilities on shore and the various formalities that might have to be met. He has already launched his plane off the *Ile de France* as she neared port at both ends of her run.

An amphibian is necessary because the

save from 20 to 36 hours on the delivery of transatlantic mail. The plan will only be available to passengers after it has been thoroughly tested out with mail.

Picking Up Mail in Flight

SINCE the function of the airplane is above all to save time, it is a fascinating idea that a plane should be able to pick up or discharge a mail or freight load without landing. *Air Transportation* reports some interesting experiments in this direction, made by the inventor, Dr. Lytle S. Adam



A demonstration of the device for picking up mail bags from a speeding plane. At left is the reel carried on the plane, and at right, a model of the trough



and



... via Western Electric

THE very program that goes on the air through the well-known Western Electric microphone and broadcasting equipment can come into your home through the Western Electric No. 560-A.W. loudspeaker!

Wake up your radio with this new voice.

Let it tell you of the wonderful things there are in the air — things you do not suspect and cannot enjoy until you have a loudspeaker that

brings them to you, in every delicate tone from the highest, sheerest violin tremolo to the deepest, fullest 'cello note.

All-around quality is inherent in this Western Electric loudspeaker. It is part of a 50-year old tradition covering a whole family of related products in the field of communication, including the nation's millions of telephones and network of switchboards and cables.

Western Electric

LOUDSPEAKER

Distributed by

Graybar
ELECTRIC COMPANY

Through authorized dealers everywhere

Industries From Atoms

A Department Devoted to the Advancements Made in Industrial and Experimental Chemistry

Tiny Tablet Sterilizes Drinking Water

"SOME little bug is going to find you some day" ran the pessimistic refrain of a song popular when "germs" first gripped the public's imagination. The little bug's chances of connecting get slimmer with each advance of chemical science, and now with the announcement of succinchlorimide, the drinking water route to our vitals is barred to him. Developed by the United States Army Medical Corps, succinchlorimide is prepared in tablets, one of which, simply dropped in bacteria-infested water, promptly and permanently terminates the malicious career of the disease carriers.

Succinchlorimide is expected to prove a great boon to soldiers in the field, campers, tourists, and others who often find themselves in the open country without any effective means of sterilizing water, said Major C. B. Wood of the United States Army Medical School, who discussed the new disinfectant before the Institute of Chemistry recently. Major Wood expects the substance to be officially adopted by the Army and Navy Departments.

"By working with a derivative of succinic acid containing active chlorine, we hit upon this new succinchlorimide," says Major Wood. "A tablet or two of this will kill all disease-producing germs in a canteen of water. The taste is barely changed. The compound does not—as far as we know—deteriorate, this giving it a decided advantage over bleaching powder, which was formerly used for the purpose."

Dust Induces Rain

ALTHOUGH the chemist was one of the first to brand the claims of professional rain-makers as nonsense and quackery, he is interested in the possibility of inducing precipitation by truly scientific methods.

While it is impossible to produce rain from an atmosphere that does not contain sufficient moisture, scientists have found that various forms of dust, added to air saturated with moisture, bring about precipitation.

An interesting demonstration of this phenomenon was given before the Institute of Chemistry recently by Professor C. F. Knipp, of the University of Illinois. Taking a vessel in which the air had been saturated with moisture just short of precipitation, he introduced dust by lighting a match near the retort and allowing the smoke to filter in. Immediately the fog turned into rain.

There is a mathematical reason for this assistance from smoke, or any other dust, in making rain. The drop of water gets itself wound around a particle of dust as a nucleus and therefore falls with greater force. Raindrops are sometimes as large as one-twentieth of an inch in diameter.

In some parts of the country, firing of cannon has been employed in making the rain come down. This has been believed to be through aiding atmospheric condensation, but what really happens is that the firing of the cannon does not bring the rain down so much through concussion and condensation as through the dust raised, which acts as nuclei for the condensation.

Not Angry — Just Too Sweet

THE angrier one gets, the sweeter he becomes, declared Dr. Oliver Kamm, director of the Chemical Research Department of Parke-Davis and Company's laboratories at Detroit at a recent session of the Institute of Chemistry.

"Anger increases the secretion of the suparenal gland, the blood pressure is raised and the sugar content of the blood is increased," said Dr. Kamm. Sugar is a

fuel for the blood, it was explained, and it is needed in increased quantity during any excitement.

Heretofore, science has been able to make but a limited study of the glands, believing that each had but one hormone, or speedier-up of body processes. But now, according to Dr. Kamm, who is an authority on glandular chemistry, two hormones have been discovered in one gland at least.

"Later on, when we refine our work," he said, "we may discover more, and eventually, it is hoped, science will be able to manufacture them synthetically."

"It has already been discovered," continued Dr. Kamm, "that the pituitary gland possesses two hormones. These are both so closely alike that they have been called chemical twins. But the functions are different, one being used in raising blood pressure and the other in aiding child-birth."

"Possibly the thyroid will be the next gland to yield a second hormone."

Vitamins Glorify the Oyster

VITAMINS keep cropping up in the most unexpected places and give us new respect for some of the foods we have been eating all our lives without giving them proper credit for supplying us with these mysterious substances so vital to our health.

One of the latest investigations conducted by the Bureau of Chemistry of the United States Department of Agriculture glorifies the oyster as a good source of vitamins A, B, and D. Fresh Chesapeake oysters were frozen, ground, and fed to albino rats. Two grams of oyster furnished sufficient vitamin A to cure rats of xerophthalmia.

Tests made by the curative method showed that 3.5 grams contained nearly



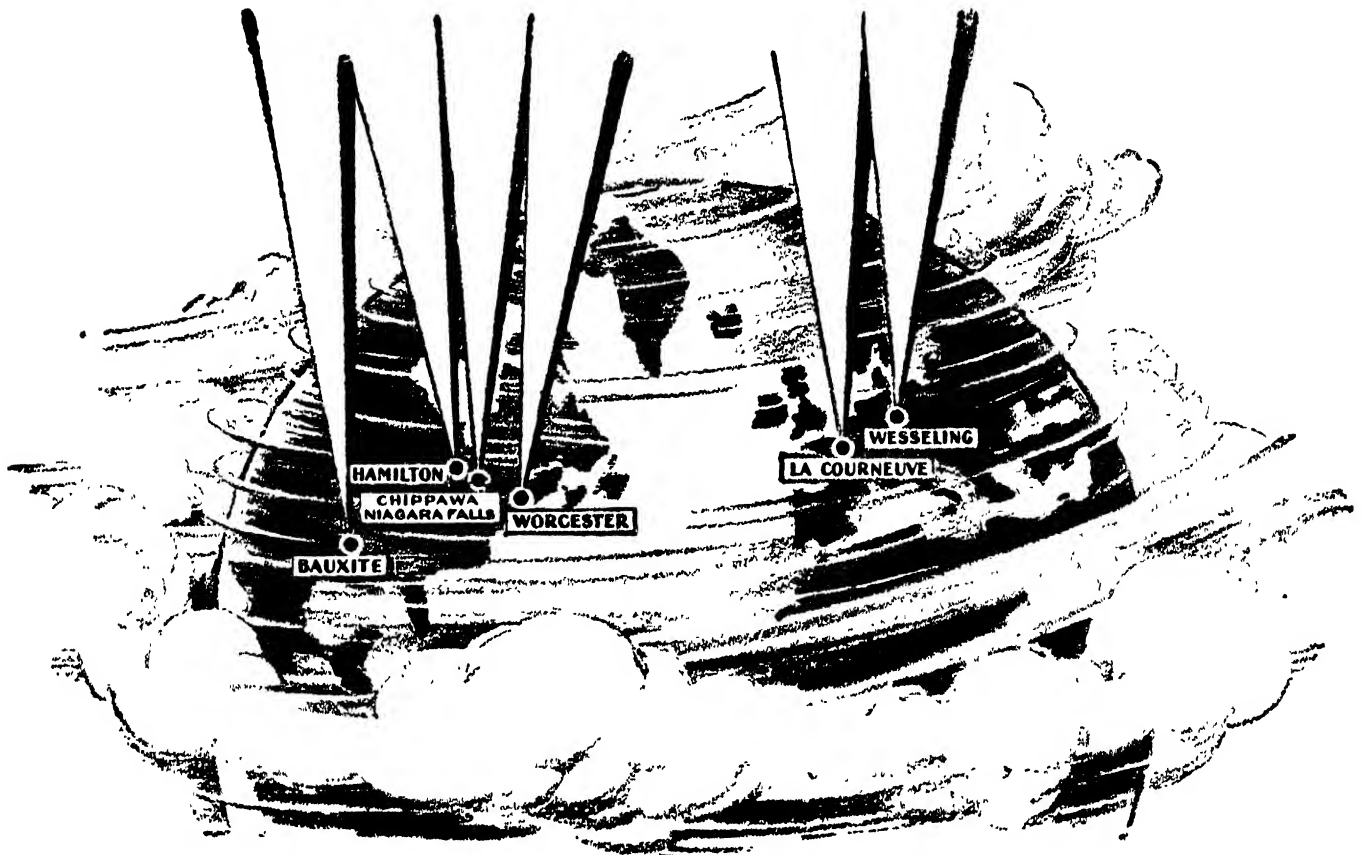
This rotary lime kiln (left) would be remarkable for its size alone, as it is 125 feet long, eight feet in diameter, and is built of five-eighths inch plate. From a technical point of view, however, it is interesting as an example of the application of welding to the construction of large



equipment. This particular kiln was tested against two others of riveted construction (right) and found to be the stronger. Also, the omission of butt straps reduced the weight 14 percent, and thus saved considerable in first cost and in lower power consumption and upkeep

For All the World—

Norton Abrasives



The part that abrasives and grinding play in our life today is most unusually portrayed in a motion picture film, "The Age of Speed." Suitable for meetings of civic clubs, engineering societies, industrial organizations. Loaned upon request.

NORTON abrasives, trade-marked Alundum and Crystolon, are made to meet the requirements of metal workers the world over.

Norton manufacturing facilities include bauxite mines in Arkansas, electric furnaces at Niagara Falls, N. Y. and Chippawa, Canada, grinding wheel making plants in Worcester, Mass., Hamilton, Ontario, La Courneuve, France and Wesseling, Germany.

Norton grinding machines, floors, refractories and porous plates are produced in the home plant in Worcester.

NORTON COMPANY
WORCESTER, MASS.

NORTON

Grinding Wheels
Grinding Machines



Refractories-Floor
and Stair Tiles

enough vitamin B to supply the needs of young rats. For long continued normal growth, however, a little more than five grams was required. Five grams of oyster given to rachitic rats daily for 10 days induced slight calcification of the bones

studied by chemists, it was found that helium gas was one of the products formed by the "decay" of this remarkable substance. Still later, helium was found to exist in small amounts in some natural gas. Romantic as is the history of helium,

countries which have natural gas and little petroleum, or in countries which have neither. Fuel experts look with interest on the experiments and believe that they may bring some startling changes.

Since natural gas contains the same elements as lubricating oil, namely hydrogen and carbon, it is only necessary to re-arrange the atoms into more complicated molecules to convert gas to oil. Dr. Lind's experiments indicate that electronic bombardment of the molecules may bring about the re-arrangement at the will of the scientist, once he learns to apply and control his new tool.



The non-rigid C-7, the first airship to be inflated with helium

comparable with that produced in the same length of time by four milligrams of good cod-liver oil. Thus those who like oysters may find added satisfaction in the thought that they are taking their vitamins while indulging their palates.

In England, British research experts have found a way to produce what they call a synthetic vitamin D by the use of ultra-violet light. Because of the comparative shortage of natural sunshine, it is proposed to use this process to increase the health-giving properties of butter and other foods to make up for the lack of sunlight. It is claimed that foods thus treated cure tendencies toward such diseases as rickets which result from improper diet and insufficient exposure to ultra-violet light.

Romance of Helium Gas

BEFORE anyone had ever seen or heard of the element helium, chemists were convinced that such a substance existed somewhere. This belief was based on a gap in the periodic table—that classification of all the known elements in order of their atomic weights which disclosed the family relationship of certain groups and made possible the prediction of the properties of undiscovered elements which would fit in the blank spaces.

And as they say in the bed-time stories—where in the world did they find helium? The strange part of it is that this strange gas was first discovered, not on the earth at all, but on the sun by means of the spectroscope. Later, when radium was

modern applications of its useful properties are equally appealing. Foremost, of course, is its use in lighter-than-air craft, a development which must be largely credited to the United States Navy. Although not possessing quite the lifting power of hydrogen, helium is non-inflammable and consequently is much preferred for safety considerations.

From its function in the clouds, helium now descends to an equally romantic role in the waters under the earth, since it has been found to be ideally adapted, in mixture with oxygen, for the mitigation of "caisson sickness" or "the bends" in deep sea diving and underwater work.

The illustrations show the first dirigible inflated with helium and some views of one of the very few plants producing the gas commercially.

"Radio Chemistry" Gives Promise of Synthetic Oil

"RADIO Chemistry," a new field in chemistry, which is one of the results of the discovery of radium, seems to make possible the breaking up of a heavy petroleum into gasoline. By a similar method, light natural gases may be used to form the heaviest oil.

This wizardry of chemistry, recently described by Dr. Samuel C. Lind, director of the University of Minnesota School of Chemistry and former director of the Bureau of Mines, may be of no practical importance at the present time in this country, but it is likely to be important in

Millions in Precious Metals Used in American Mouths

THE amount or value of the precious metals consumed in dentistry is probably amazing to most people. The American people use almost as much gold, silver and platinum to modernize their masticating facilities as they do to adorn themselves with jewelry. In view of the magnitude of this consumption of the precious metals, it is not strange that metallurgists have recently turned their attention to the

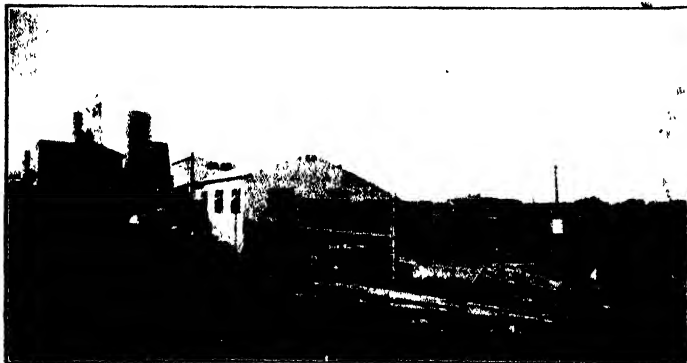


Synthetic mixtures of oxygen and helium are employed in this double compartment caisson for mitigation of "bends" or caisson disease. Double doors allow entry to main compartment by first building up pressure in outer compartment

specific and very exacting requirements of the dentists.

Reginald B. Williams, addressing the American Institute of Mining and Metallurgical Engineers recently, explained that the demands made upon manufacturers by the dentists are extremely varied. They must supply metals of tensile strength ranging from approximately 30,000 to 100,000 pounds per square inch and even more. The metals must be workable and

(Please turn to page 470)

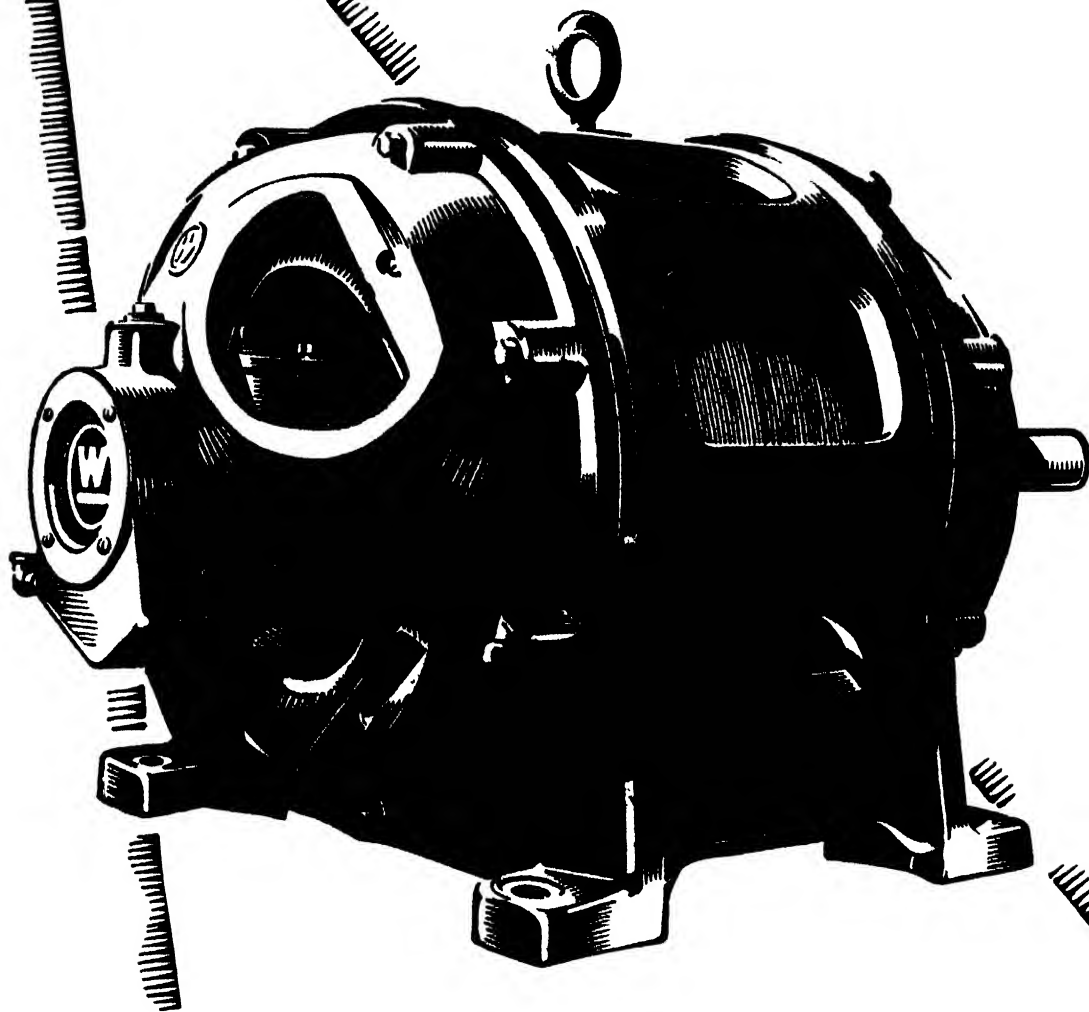


The helium extraction plant of the Helium Company, from which helium is shipped to Lakehurst, New Jersey



A battery of Cooper gas compressors used in the Helium Company's plant. Helium is recovered from natural gas

**MORE THAN THE MOTOR
THE BEARING RESTS ON**



In the chain of modern mass production no single part is independent of the others. Motor performance is more important than ever before; motor bearings are more important. . . . Westinghouse motors have *Sealed-Sleeve bearings*. Oil can't get out; dirt can't get in. The chief cause of motor burnouts—oil soaked windings—is eliminated.

WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY

East Pittsburgh Works, East Pittsburgh, Pa.

Sales Offices in all Principal Cities of the United States and Foreign Countries

Westinghouse Motors
With Sealed-Sleeve Bearings



Strays From the Ether

A Monthly Review of the Progress Made In All Branches of Radio Communication

Tracing the Radio Echo

VAGRANT radio waves which circle the North Pole and return to receivers in the earth's temperate latitudes have been

roof" and return, and not nearly as far as the round-the-world path. It requires about one seventh of a second for radio energy to circle the earth, since radio energy

Alum Bay, for transmission through ether. One shilling to Bournemouth and thence by postal telegraph, 15 pence, to Cambridge."

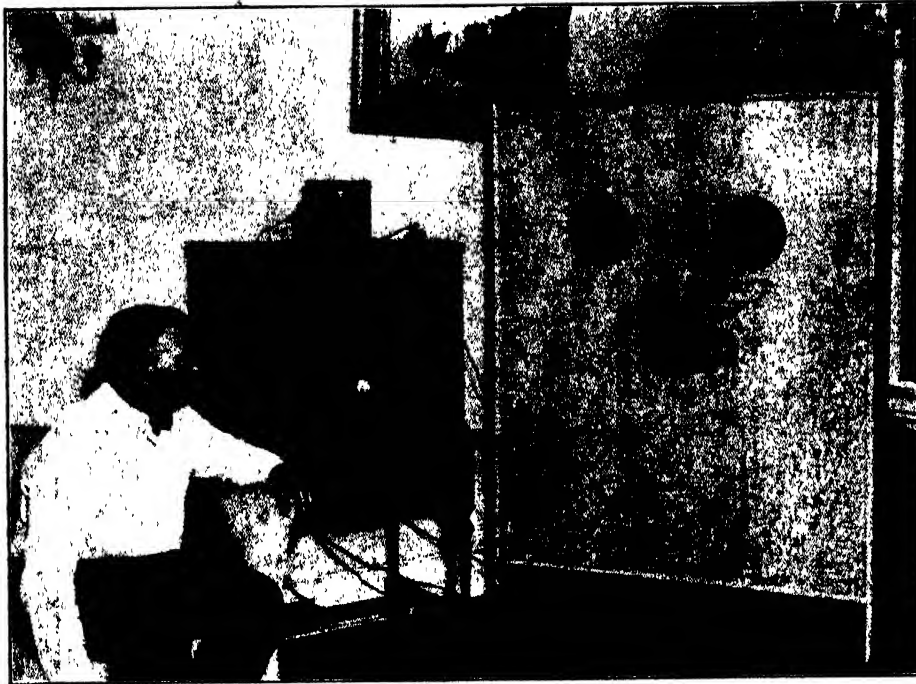
During the 30 years which have elapsed since this incident at the Isle of Wight, wireless telegraphy has achieved more than Lord Kelvin could have foreseen, and today there is hardly a corner of the world which cannot be reached by wireless communication in which wireless does not take its part in daily communication routine.

Where Radio Reception Is a Crime

HOW often have you said or heard, "It is a crime to broadcast such stuff as that?" And the speaker may literally be right. But would you call it a crime to listen in?

In European countries where receiving sets are subject to a Government tax, a spy system is unavoidable if the license fee is to be uniformly and equitably distributed. This involves the imposition of penalties upon the so-called radio pirates.

In Soviet Russia, for instance, to own and operate a receiving set without Government license is an infraction bordering upon criminality, if we are to measure the offense by the penalty imposed. The way of the transgressor is exceedingly hard if he is proven guilty of "clandestine listening."



Here is a real radio enthusiast. O. Mampe, of Palisade, New Jersey, has built this baffle-board loudspeaker. The board measures four and one half feet wide by five and one half feet high. Three dynamic speaker units are used

given by Dr. J. Barton Hoag of the Ryerson Physical Laboratory, University of Chicago, as the probable cause of radio "echoes" which scientists have as yet been unable to explain.

Signals which have traveled entirely around the world and returned to be recorded near the point of transmission, or radio energy which is apparently directly reflected back to the earth from the "radio-roof," account only in part for the echo signals noticed by Dr. Hoag and other experimenters, according to a University of Chicago report.

It was pointed out that the returning energy of the echo was received before the elapsed time required for the signal to circle the globe, but too late to be considered as returning energy reflected from the "radio-roof," or Kennelly-Heaviside layer.

Dr. Hoag suggests that at the North Pole the "radio-roof," or reflecting layer, forms a deep inverted bowl above the earth, rising to perhaps 300 miles above the normal height of the layer. He said the radio waves might revolve in this bowl before descending to actuate his electrical recording apparatus.

According to Dr. Hoag, the "echo" signals are received on a high-speed photographic film, which is exposed at the rate of five feet per second, at intervals of .01 to .04 of a second after the main wave. The time interval indicates that the signal is traveling much farther than vertically to the "radio-

travels at approximately the same speed as light, or about 186,000 miles a second.

Dr. Hoag and his associates believe the results attained from the experiments will be fruitful in solving long distance radio transmission troubles. It has been found necessary to work at night because the "echo" signals fade out as the sun rises.

The First Paid Radio Message

THIRTY years ago radio telegraphy was officially adopted as a public means of communication when Lord Kelvin paid Senatore Marconi one shilling for the transmission of the first paid message.

This historic message was sent by Lord Kelvin, who at that time, with Lady Kelvin and Lord Tennyson, was visiting Senatore Marconi's experimental wireless station at Needles, Isle of Wight. In order to show his appreciation of the work the inventor of radio had accomplished and to illustrate his belief in its commercial future, Lord Kelvin insisted upon paying one shilling each for wireless telegrams which he sent to Sir George Stokes, at Cambridge; to Lord Rayleigh and Mr. W. H. Preece, in London; and to Dr. McLean, his chief assistant in the physical laboratory of the University of Glasgow.

The message from Lord Kelvin to Sir George Stokes was as follows:

"This is sent, commercially paid, at



A rear view of the baffle-board speaker shown above. The three units and the power amplifier are plainly visible. The baffle itself is made of seven-eighths inch wood

The maximum penalty is three years imprisonment.

A boy in Leningrad, recently haled to court on a charge of operating a radio receiver without license, was found guilty and sentenced to hard labor for a period of three months. The judge, in determining

Step into the laboratory, and see why LISTERINE

full strength is effective against
SORE THROAT



Have you tried the new
LISTERINE SHAVING
CREAM?

Cools your skin while you
shave and keeps it cool
afterwards. An outstanding
shaving cream in every
respect.

Prevent a cold this way? Certainly!

Millions of ordinary colds start when germs carried by the hands to the mouth on food attack the mucous membrane. Being very delicate it allows germs foothold where they develop quickly unless steps are taken to render them harmless.

You can accomplish this by rinsing your hands with Listerine, as many physicians do, before each meal. Listerine, as shown above, is powerful against germs.

Use only a little Listerine for this purpose—and let it dry on



the hands. This simple act may spare you a nasty siege with a mean cold.

It is particularly important that mothers preparing food for children remember this precaution.

WHY is Listerine full strength so successful against colds, sore throat and other infections?

The test outlined below answers the question scientifically and convincingly. It discloses the power of Listerine—unchanged in 47 years.

Step into the laboratory a moment. In one test tube are 200,000,000 of the *M. Aureus* (pus) germ. In another, 200,000,000 of the *B. Typhosus* (typhoid) germ. These are used by the United States Government for testing antiseptics.

Now Listerine full strength is applied to them. A stop-watch notes results. Within 15 seconds every organism in both tubes is dead, and beyond power to harm the body.

With this evidence of Listerine's germicidal power, appreciate why you should gargle with Listerine at the first sign of sore throat—for sore throat, like a cold, is caused by germs.

Listerine full strength may be used with complete safety in any body cavity. Time and time again it has checked irritating conditions before they became serious. You can feel your throat improve almost immediately. If not, consult a physician. The matter is then no longer one for an antiseptic.

For your own protection use Listerine systematically through the winter months. It may spare you a long siege of illness. Lambert Pharmacal Company, St. Louis, Mo., U. S. A.



Chief radio operator Malcolm P. Hanson of the Byrd Antarctic Expedition, with some of the airplane radio equipment that the expedition will carry

the penalty, gave as his reason for "leniency" the youthfulness of the offender. And yet, despite the severity of the punishment meted out to this class of lawbreakers, it is estimated that 15 percent of the broadcast listeners in Leningrad are radio pirates, in the light of the Government definition.

Balm For Weary Radio Souls

WRITING under the *nom de plume* of Ariel, a columnist in *Popular Wireless* (England) advances some valuable suggestions to a correspondent. We reprint Ariel's paragraph herewith:

"A reader who professes himself to be bored with the everlasting reception of jazz, et cetera, from distant stations, asks me to suggest 'fresh woods and pastures new.' Very well! I suggest that he study the theory and practice of radio and then explore and try the methods of measuring signal strengths; and the direction and characteristics of X's [static. *Ed.*]. Frame-aerial [loop. *Ed.*] work is fascinating, but needs a little scientific knowledge. And then there is a world of space for experiment in the observation of short-wave transmission. Let him learn Morse and then plunge into the vortex of stations all over the globe."

Power to Spare

"POWERFUL enough to fill a large auditorium with music!"

The person who is about to purchase a loud speaker may wonder why this statement, applied to dynamic speakers, should interest him when he only desires a speaker with volume enough to fill a living room.

Such statements should mean as much to the prospective purchaser of a reproducer as "80 miles an hour" means to the purchaser of a motor car.

Motorists have learned that even though they may never want to travel above a moderate speed, cars rated to go much higher ride much smoother at the lower speeds than do those, the maximum speed of which is low. Vibration at moderate speed is reduced to a minimum in high powered cars.

And so it is with loud speakers.

Although a listener may never care to operate his speaker at a volume in excess of that necessary to make the tones audible a

few feet from the receiver, smooth, true tones are made possible by the great reserve power of a dynamic speaker. Reserve power is just as useful in a reproducer as it is in an automobile. When an auto comes to a high hill the reserve power permits it to go up without loss of speed. When a radio receiver pulls in a weak signal, the dynamic speaker's reserve power permits it to be heard without loss of volume.

British Colony Broadcasting Station

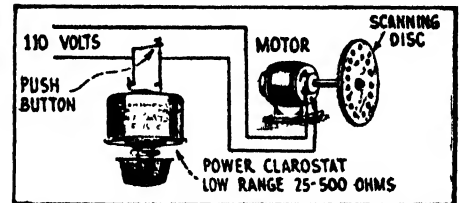
KENYA, South Africa, has the distinction of being the first British colony to possess a short-wave broadcasting station.

Controlling the Television Scanning Disk

ONE of the tricks in achieving successful television reception is the synchronization of the receiving scanning disk with

that at the transmitting end. This phase calls for an exceedingly accurate control of the speed of the motor which drives the receiving scanning disk, for otherwise the image is distorted very much after the fashion of the reflection of one's self in the trick mirrors at amusement parks—or, worse still, there may be no image at all to look at. While automatic control is possible, it is costly and complicated at this time, and it is only adding confusion to the delicate work of getting strong images, according to S. H. Anderson of the Clarostat Manufacturing Company.

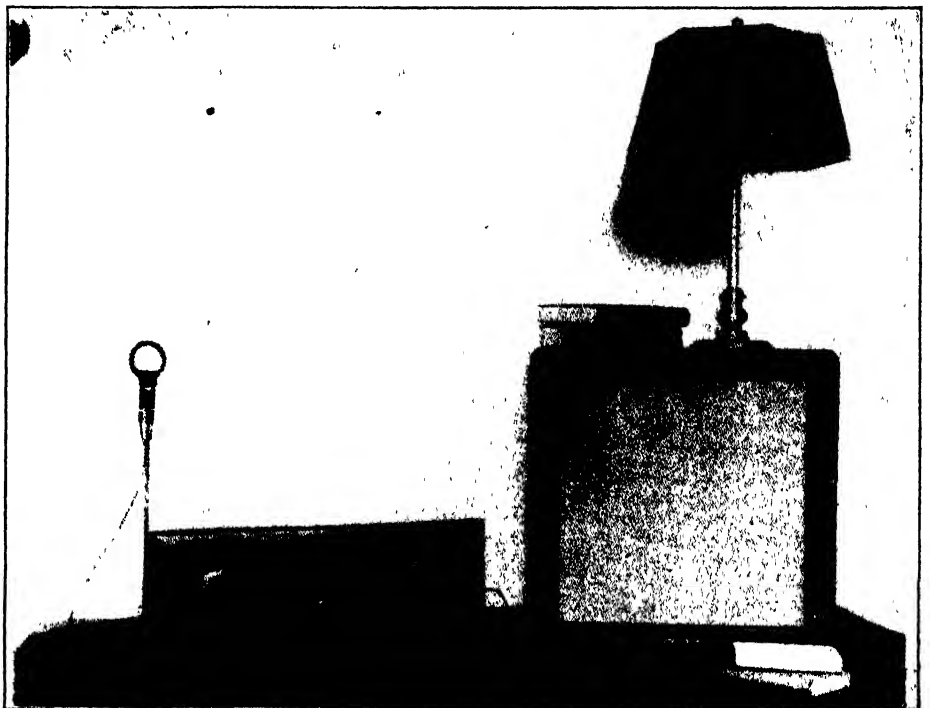
"At present the most satisfactory method of obtaining synchronization in television reception," stated Mr. Anderson, "is manually. A power clarostat is introduced in the motor circuit, as shown in the accompanying diagram. Because of the stepless control afforded by this device, it permits



How a variable resistance and a switch or push-button may be employed to regulate the speed of a television scanning-disk motor

variations of speed in fractions of a revolution per minute. A push button is also introduced for the purpose of momentarily speeding up the motor when bringing the disk into synchronism."

This arrangement is in keeping with that employed by Dr. Alexanderson in developing his television system, who says: "We took a standard motor made for household use and manipulated its speed by an electric hand control. With a little practice and co-ordination between the eye and the hand, it is possible to hold the picture in the field of vision as easily as one steers one's car down the middle of the road."



This radio receiving set and loudspeaker was demonstrated recently at a German exposition held in Berlin. With the tiny loop aerial shown at the left, long distance reception is claimed. No definite details are available

B. C. Forbes' Newest Book **HOW TO GET THE MOST OUT OF BUSINESS**

Sent for Seven Days' Free Examination

WHY THIS BOOK

This book, drawn largely from intimate contact with nationally-known men of affairs, offers suggestions on how to get the most out of business.

The "most" what? What you really want to get.

Money? Yes and No.

B. C. Forbes knows millionaire and multi-millionaire failures, men who have miserably missed out in life, men who have followed trails leading to pelf and power but also to disillusionment, unhappiness, remorse.

He knows other men of affairs who, while winning equally as much money, have won genuine success—friendships, reputation, influence, contentment, true joy in living.

Material success is not true-blue success unless it brings mental success. Too often financial success is pursued at the cost of mental success. And, tragically, such chasers usually do not have their eyes opened until they begin to hear the grave calling them.

An enthusiastic, joyful, vigorous, zestful life is not incompatible with financial success. It makes, rather, for financial success if the right signposts are followed.

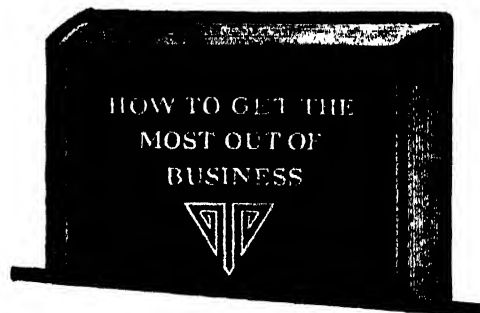
This book draws attention to these signposts.

It doesn't draw illustrations from the dead past but from the living present, from the careers and the home-brewed philosophy of men known throughout the world of finance, industry, commerce, from the experiences of men wrestling with the same difficulties and problems as beset the reader.

The pace to-day is so swift, the battle is so strenuous, concentration is so closely focussed, the immediate objective so engrossing that signposts, danger signals, are liable to be overlooked—and then the goal reached turns out to be the wrong goal, a goal only of disappointment, bitterness, wormwood, gall.

And it is all so unnecessary!

The pages of "How to Get the Most Out of Business" may induce some of the busy men for whom they are primarily written to *Stop! Look! Listen!* in time to steer their course at least a little more effectively along the paths producing the most satisfying rewards and leading to that brand of success which yields joy and causes its possessor to radiate joy.



What Some Reviews Say

"The readers will find many of their problems identical with those presented by the author of this neat little volume. The experiences are taken from the actual business life of today and readers will at once see themselves reflected on the printed page."—*Raleigh, N. Y. Times.*

"He (B. C. Forbes) points the way in stimulating vim to the right objectives—the book is liberally sprinkled with the epigrams that have made FORBES' name famous."—*Boston Globe.*

"Every phase of professional and business life is set forth for the guidance of those who are seeking success."—*Boston Evening Transcript.*

Sent on Seven Days Approval

We shall gladly allow you to examine "How to Get the Most Out of Business" for seven days. Return it, at our expense, within seven days after you receive it, or remit \$2.50 as payment in full. The option rests with you. You will be the sole judge of the book's value to you.

-----Just fill in and mail coupon below-----

FORBES MAGAZINE,

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Date.....

All right! Send me a copy of B. C. Forbes' newest book, "How to Get the Most Out of Business." I will either return it to you, at your expense, without further obligation to me, within seven days after I receive it, or I will remit \$2.50 as payment in full.

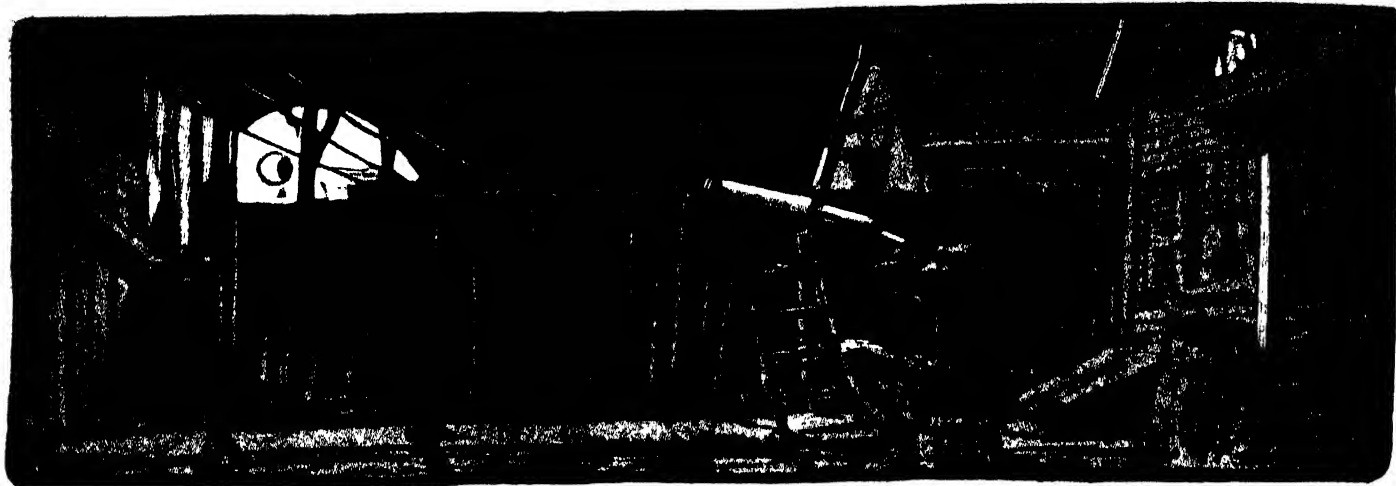
Please quote me on.....copies.

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Sci—



The Back Yard Astronomer

A Department Devoted to Interests of the Amateur Telescope Maker

G. F. HOFFERBERTH, 49 Birchwood G. Avenue, Dayton, Ohio, who sends in pictures of an especially trim looking telescope of the double forked type described in "Amateur Telescope Making" (new edition, page 26) writes as follows:

"I send prints of a reflector which I have recently completed. The mirror is six inches in diameter with a 48-inch focal length. One of the outstanding features of this design is that the tube with all of the optical parts can be removed from the yoke in a few minutes and taken indoors for protection. This I find is a great convenience as I have no housing, and one feels much better with this part of the telescope indoors.

"The yoke and base are made of one and three-quarters by three-inch birch, glued and screwed together, and the whole is covered with spar varnish. This construction is very strong. However, it is not so heavy that it can not easily be moved from place to place if necessary, and with a little care in placing, I find it to be very steady.

"I think the most interesting part of this work, other than the star gazing, is making the mirror. This, although tedious, is interesting from the very start, and one soon loses all of the fear he ever had about working glass. Even the testing with the knife-edge, while trying upon the eyes, has its great reward when the telescope finally is tried on the Moon or stars. I expect to essay a 10- or 12-inch mirror soon."

With this issue we at last announce the publication of a second and revised edition of the SCIENTIFIC AMERICAN instruction book "Amateur Telescope Making." The word "revised" is, however, much too mild, for the book has been considerably more than doubled in length, now consisting of 286 pages, instead of 102 as formerly. Virtually all of the matter contained in the first edition has been retained, and thus the beginner may continue to use the book as before—to instruct in making a satisfactory telescope capable of magnifying 50 to 200 diameters without expending more than 25 or 35 dollars for the entire job.

To the elementary instructions by Porter, Ellison, Ions, Pierce and others, much new matter, some of it more advanced, has now been added. Porter adds eight new chapters: a chapter of "wrinkles;" a chapter

telling how to adjust the telescope and put it into alignment with the co-ordinates of the heavens; a chapter explaining how a tele-

scope having setting circles is used to find the otherwise undiscoverable show-pieces of the skies; one describing a number of



Wide World

A telescope made by G. H. Lutz. The mirror is made of the extremely hard alloy, Stellite, as described in the new edition of "Amateur Telescope Making"

ways to bring the observer indoors away from the cold of winter and the mosquitoes of summer, yet use the telescope to almost equal advantage; practical instructions for making a prism or diagonal; a chapter telling how to make an optical flat or plane surfaced mirror; one on making the Cassegrainian type of telescope, and one which gives complete and detailed instructions for designing and making both the lenses and the metal parts of an eyepiece of high quality and appearance. The instructions for making a flat and a Cassegrainian telescope are virtually unique; they have never been in print anywhere before, in satisfactory detail.

Professor Charles S. Hastings of Yale, who for years designed the curves of the famous Brashear telescopes, contributes to the new volume two chapters on eyepieces, giving the amateur a full insight into the many optical principles involved in eyepiece design, selection and use.

Ellison's treatise on the objective lens has been included in the new edition. This



Mr. Hofferberth's telescope

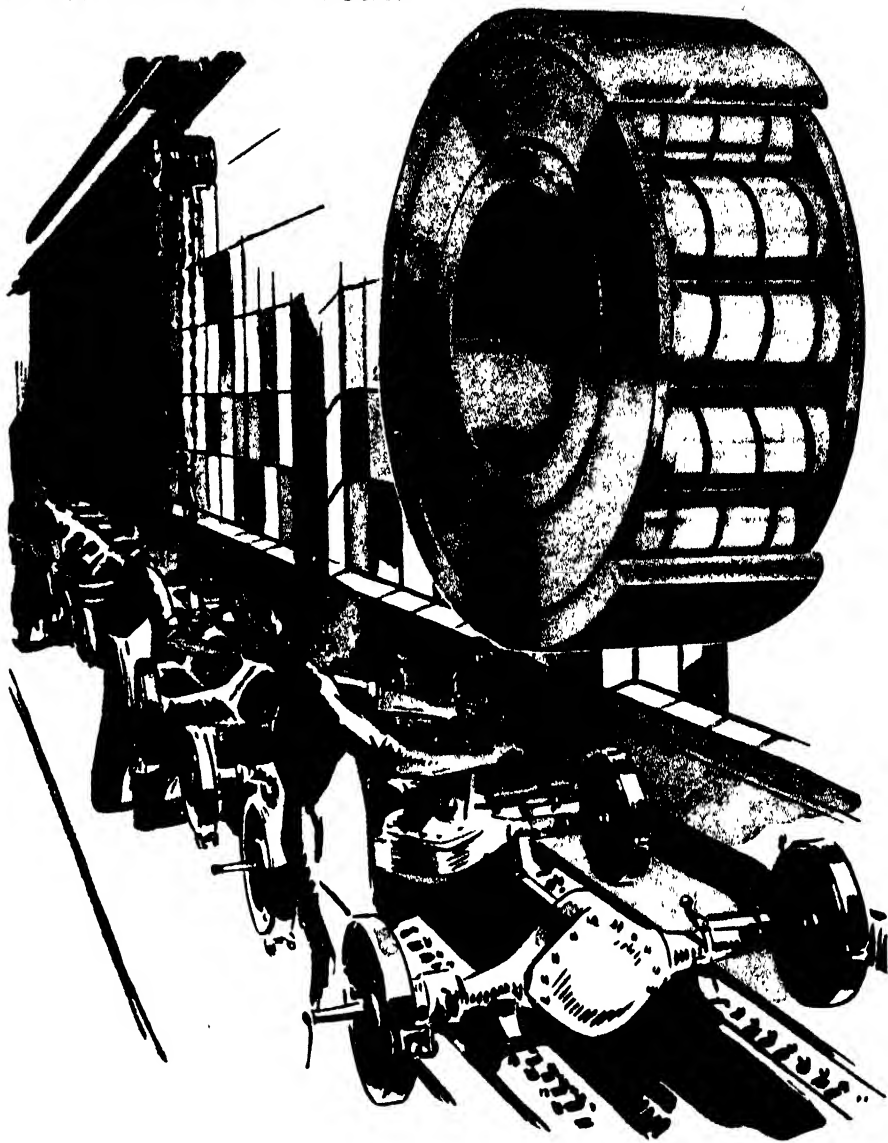
is the first time we have emphasized the refractor as a suitable outlet for the mechanical instincts of the advanced amateur. There has been a small but steady demand, during the past two years, for these instructions and we therefore obtained from the Rev. Mr. Ellison a complete revision of the theoretical part of his original treatise on the objective lens. No treatment of the subject even approaches that by Ellison in length and usefulness.

Silvering has been a stumbling block for the average amateur, and we confess that the instructions contained in the first edition of "Amateur Telescope Making" were not sufficiently well rounded to obviate certain mistakes. The section on silvering has therefore been expanded by the addition of six new pages.

Many advanced amateurs wish to construct machines for grinding and polishing their mirrors. Hand work is equally good although more laborious. The new edition contains a thoroughly illustrated section on machines, describing those used by several workers, and reprinting, with the original illustrations, the description by Ritchey of the type of machine he uses for all his work.

A. W. Everest contributes a complete, practical, illustrated section, telling exactly

(Continued on page 466)



A message from motordom

SINCE the earliest days, motor car manufacturers have relied upon Hyatt to develop anti-friction bearings that would overcome problems peculiar to their products.

The satisfactory manner in which Hyatt has cooperated and continues to cooperate with these manufacturers is evidenced by the large number of fine cars, trucks and busses that are Hyatt equipped.

Millions and millions of motor car miles are proving the mettle of Hyatt Roller Bearings... the same bearings which industry is using so successfully in material handling equipment, line shafting and machinery in general.

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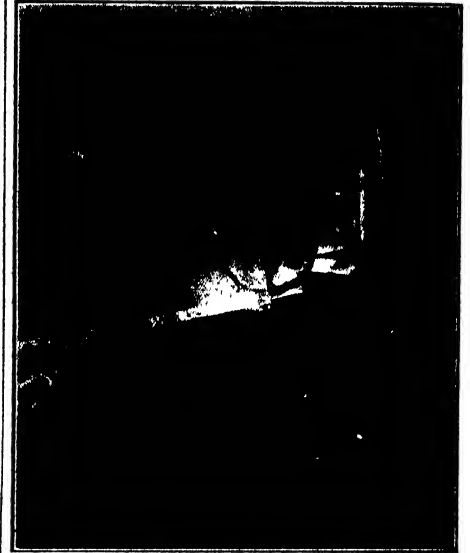
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PRODUCT OF GENERAL MOTORS

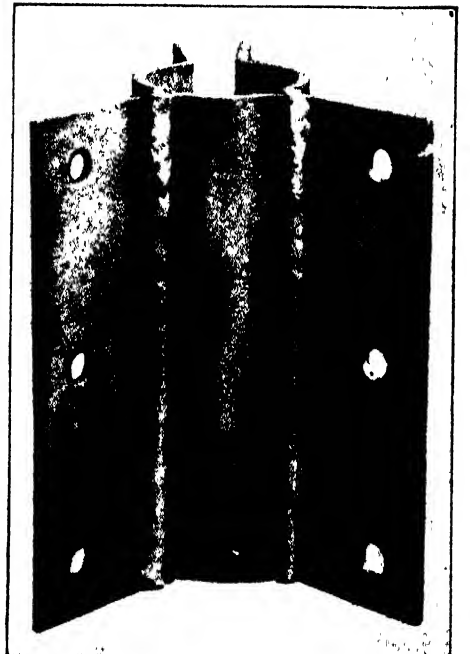
The Scientific American Digest

(Continued from page 446)

since details of the process were reserved until satisfactory commercial applications had been worked out. Since then research engineers of the Lincoln Electric Company have perfected a practical welding head for utilizing the Electronic Tornado and have obtained highly satisfactory results.



Above is shown the new device in action welding oil-derrick corner clamps. Its action is entirely automatic. Below is a finished clamp made of three pieces welded together automatically without filler



The electric arc is normally a difficult phenomenon to control. It creates its own magnetic field, and in the passage of the welding current through the parts being joined, creates other magnetic fields of variable direction. The arc, therefore, tends to wander about seeking the path of least resistance, between its own magnetic field, produced by the passage of welding current, and the piece being welded. By super-imposing a strong magnetic field on the arc flame, a control of the arc is established. This control permits the arc to travel through the variable fields with-

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out disturbance. The arc is given a gyratory motion of great velocity which also tends to hold it in a straight line.

A new automatic welder, designed to produce oil-well tubular derrick corner clamps, has been constructed to operate on the Electronic Tornado principle. In this machine there are two of the new type welding heads with their electrode holders crossing each other at a sharp angle. This construction is of peculiar interest for with an uncontrolled arc it would be impossible to operate two flames in such close proximity. One would continually blow the other out. With the Electronic Tornado head, however, they work smoothly and without conflict. The clamps produced by this machine are made from three pieces of plate whose aggregate radius bending totals a complete circumference. The assembled pieces from which these clamps are made are fed into the big welder and are carried under the arc in a continuous progression by a chain on which dogs are set at the proper intervals.

This new welder is said to place welds at the rate of better than 40 feet an hour for each head, which is an exceptionally high velocity. No filler rod is used; the arc fuses the various plates inseparably together.

Transparent Steel New Aid to Science and Industry

ON the Kaiserdam in Berlin an unusual exposition of metals used in industry was recently held. At this exposition there were instructive exhibits showing details of manufacture, use, and capabilities of various metals, but perhaps the most interesting was the exhibit of transparent steel.

This invention is the work of Dr. Karl Muller. Two years ago, Dr. Muller succeeded in producing transparent sheets of gold and nickel and today his process applies to steel and any other metal as well. Whereas by the Walz process, aluminum could be made into sheets of a tenth of a millimeter in thickness, by the method of Dr. Muller, steel can be made in sheets of a few millionths of a millimeter thickness, and as transparent as glass. Even the weak alpha rays pass through such a sheet without being diminished in intensity. The thickness of these sheets is so infinitesimal that it cannot be measured directly even by the finest instruments; it is only with the aid of their specific gravity that the thickness of these transparent sheets of steel can be ascertained. Even the hardest metals, when reduced to sheets of this thickness, become extraordinarily elastic. For example, a sheet of such steel, 15 centimeters in diameter, is stretched between two rings, while at a meter's distance is an electric fan which blows upon the steel and agitates it in the same way as when wind blows along the surface of a lake.

In the process of manufacture the sheets are produced mathematically exact and uniform as to thickness without any tears or flaws as might be expected with such extreme thinness. The steel retains its structure unchanged, its only difference being that it is absolutely colorless and transparent.

The properties of transparent steel indicate the tremendously wide scope of its field of application: it transmits light, electric currents, cathode, roentgen, and radioactive rays; it can be magnetised; it



When Locomotives Go to Sea

These immense and powerful rail travelers are so helpless when they put out to sea that they have to be picked up bodily and placed aboard ship.

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"I would like to say I won first prize in the 'biggest news of the week' contest sponsored by the 'World' for high school students. I was gratified to tell Sifton of the Sunday department that I owe much to the training furnished by your good selves. Good luck to you, and thanks!"

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has a minimum of weight; and it is a very poor heat conductor.

The uses to which it can already be applied, even at this early stage of its development, are very significant. In the province of acoustic instruments it promises to produce a new industry; here it can be used as membranes for telephone microphones, medical instruments and in speaking films. It has the advantage of reproducing tones without any distortion, as a result of its infinitesimal mass. As any membrane of measurable thickness does not reproduce very high tones, it is of great value for condensers for microphones and loud-speakers since it reproduces all audible tones—and for that matter, records even those above and below the range of hearing. Further, it is an aid in picture telegraphy because of its electromagnetic light sensitivity.

In instruments to measure pressure and temperature, transparent steel can be used to great advantage as contact membranes, because of its high sensitivity and rapid adjustability.

In the purely theoretical field it can be applied to investigations concerning the atom, such as the relation between light, electricity and magnetism, and studies concerning the cathode, roentgen, and radioactive rays. In laboratories these transparent metal sheets will be used whenever the structure of the metal is to be investigated, for, as has been already stated, the sheets preserve the structure of the metal unchanged; and wherever gases must be kept separated in a container. The I. G. Dye Industry is greatly interested in the property of transparent steel of producing tones of an inaudible wave frequency which were heretofore impossible (i.e. the mixture of previously insoluble substances in fluids, forming an emulsion).

Use Hypodermic to Season Meat

SOON the housekeeper may be able to buy her lamb or mutton with the mint sauce already in it, and chicken already flavored with mace and thyme. In France, land of famous cooks and tasty sauces, poultry and meat are now deliciously seasoned by hypodermic injection.

The new method, discovered by Dr. A. Gauduchau, makes use of a principle of physiology and injects sauces and seasoning directly into the blood stream of chicken and other fowl. In this way the flavoring penetrates to all parts of the meat.

"Intra-sauce" is the name Dr. Gauduchau coined for the fluid he uses in this new sort of cookless cookery. He has tried the method on over 200 animals, using all kinds of poultry, and sheep and pigs.

In addition to flavoring, coloring matter may be introduced in the same way to get an even hue throughout the meat, or different parts may be flavored or colored differently. Lean meats may be enriched by injection of lards or oils. For this purpose melted butter has been found the best fluid.—*Science Service.*

Huge Concrete Smoke Stack

ERECTION of a monolithic concrete chimney, 301 feet 6 inches high, the tallest in the Chicago industrial district, has just been completed at the Buffington, Ind., plant of the Universal Portland Ce-

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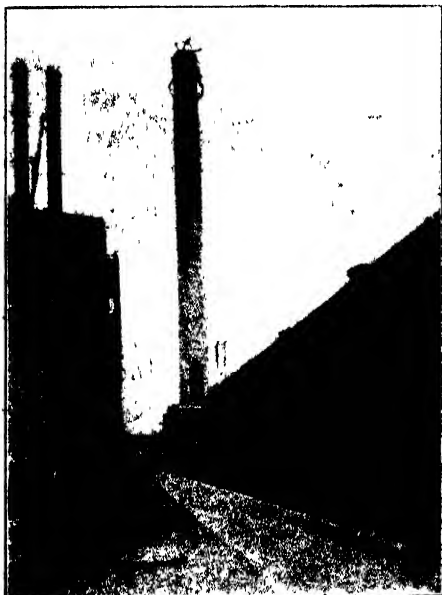
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ment Company. This chimney will eliminate a battery of small stacks now in use on the burner building of one of the mills at the plant. Powerful flood-lights playing on the chimney will make it a landmark for night flyers and it is being listed as such with the Department of Commerce.

The chimney is built in connection with waste heat boilers and the most improved type of graded resistance Cottrell precipitator, which will eliminate a high percentage of dust from gases before they pass to the chimney.

The chimney is 26½ feet in diameter at the bottom and 17 feet at the top. The



The monolithic concrete smoke stack that is 301 feet, six inches high, recently built in Indiana

walls are 18 inches thick at the bottom and six inches at the top, while the foundation is eight feet thick at the center, and three feet thick at the edges. A fully guarded steel ladder has been constructed on the outside of the chimney in 30-foot sections, allowing resting places enroute for persons climbing to the top.

A single steel form, seven and one half feet high, was used in building the chimney and a seven and one half foot section of concrete was placed every day. The chimney was designed by the engineering department of the Universal Company and the Rust Engineering Company, Pittsburgh, was the contractor.

Romans Used Glass Panes in Windows

GLASS windows are not the relatively modern things they are commonly reputed to be. According to Dr. M. Blaschke, a German ceramic chemist, they were in use in ancient Rome. Most of the panes did not exceed 12 by 16 inches in size, though a few larger ones have been found.

Glass-making, known for many centuries in Egypt, came to Rome relatively late. During the time of Cicero, who died in 43 B.C., glass objects of any kind were rarities, and glass windows were unknown. A hundred years later most households owned some, and by the time the Empire was well established, glass was fairly common. The famous mosaics of the later Empire, notably at Ravenna and Constantinople, were made largely out of bits of glass.—*Science Service.*

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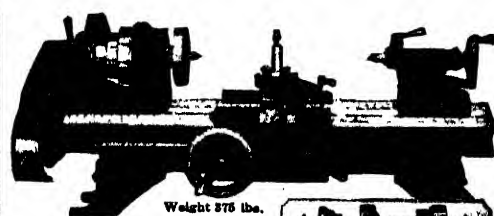
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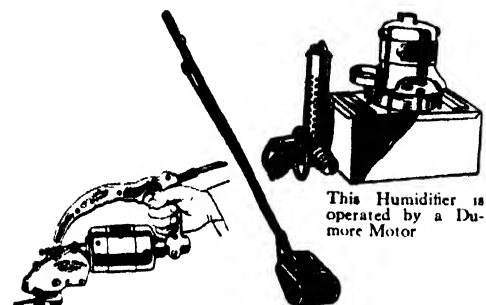


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The Back Yard Astronomer

(Continued from page 461)

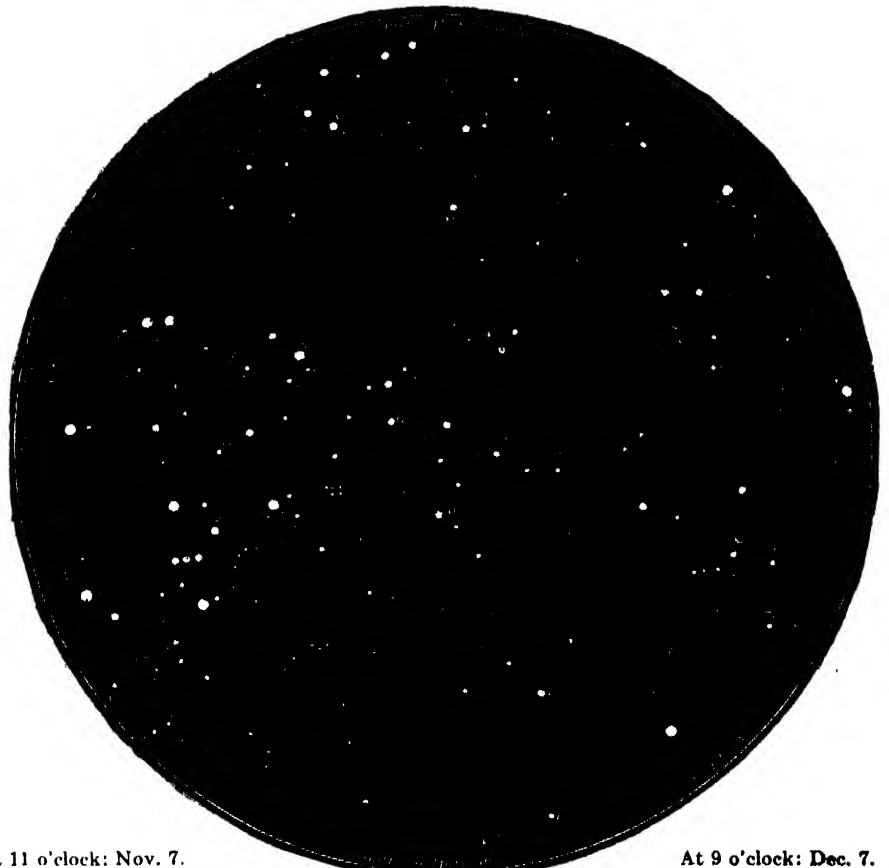
how to use the new H.C.F. (honey-comb foundation) lap which he discovered. The use of this lap cuts down the time of polishing a six-inch mirror from six hours to two.

Amateurs who want to take up something really lively will be delighted with Dr. George Ellery Hale's 22-page instructions for making the new spectrohelioscope, a

remarkable instrument which will enable them to sit in their garage or other building and actually watch the motion of those vast red prominences on the Sun which often rise 100,000 miles above its surface within the space of a few minutes. The apparatus is remarkably simple and lies within the means and capabilities of the amateur. We amateurs are indeed fortunate to have enlisted the interest and support of so famed an astronomer as Dr. Hale of Mt. Wilson Observatory. —A.G.I., Tel. Ed.

The Heavens in November

By PROF. HENRY NORRIS RUSSELL, Ph.D.



At 11 o'clock: Nov. 7.
At 10½ o'clock: Nov. 14.
At 10 o'clock: Nov. 22.

At 9½ o'clock: November 30.

At 9 o'clock: Dec. 7.
At 8½ o'clock: Dec. 15.
At 8 o'clock: Dec. 23.

NIGHT SKY: NOVEMBER AND DECEMBER

MERCURY is a morning star and can best be seen about the 9th, when he is farthest from the Sun and rises about 5 A.M. At this time he is in Virgo, about five degrees east of Spica, and appears about five times brighter than that star.

Venus is an evening star setting about 6:45 P.M. She is far south of the celestial equator and hence less conspicuous than she would otherwise be.

Mars is in Gemini and is a brilliant object. He rises at 7:30 P.M. in the middle of the month and dominates the morning sky. At the end of the month he is less than 60,000,000 miles distant, and planetary observers will be very busy with him.

Jupiter is in Aries, just past opposition, and is the brightest object in the evening sky.

Saturn is an evening star. On the 7th he is in conjunction with Venus at a distance of a little more than two and a half degrees. By the end of the month he is lost to view.

Uranus is in Pisces and comes to the meridian about 8:30 P.M.; while Neptune is in Leo and "souths" not far from 6 A.M.

The Moon is in her last quarter at 9 A.M.

on the 4th; new at 5 A.M. on the 12th; in her first quarter at 9 A.M. on the 20th, and full at 4 A.M. on the 27th. She is nearest the Earth on the 27th and farthest away on the 14th. During the month she is in conjunction with Mars on the 1st, Neptune on the 5th, Mercury on the 10th, Saturn on the 14th, Venus on the 15th, Uranus on the 23rd, Jupiter on the 25th and with Mars again on the 29th.

There are two eclipses this month. The first, a partial solar eclipse on the 12th, is invisible in the United States but can be seen shortly after sunrise throughout Europe, excepting Spain, and at other hours during the day across Asia as far as India. The lunar eclipse on the 27th is total and is visible throughout North America. The Moon enters the outer penumbra of the Earth's shadow at 1:25 A.M. Eastern Standard Time, reaches the dark shadow at 2:24; is immersed in it completely from 3:33 until 4:29; leaves the shadow at 5:39, and the penumbra at 6:37. The Moon will be high in the sky and, weather permitting, the eclipse should be well worth watching.



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Learning to Use Our Wings

(Continued from page 450)

The Dornier works at Altenrhein in Switzerland are now attempting something far more ambitious. The information available is as yet only of the newspaper variety, but this seems fairly reliable since the description given follows closely the lines of Dornier practice. The *DU-X* will resemble the Dornier *Superwhale*, and will be a monoplane of 400 feet in span. It will be powered with 12 engines of 500 horsepower each, probably arranged in three tandem sets on either side of the hull.

Owing to the huge size of the seaplane, it will be possible to enclose the engines entirely in the wing, thus saving much head resistance. The headroom inside the wing will be over six feet, so that mechanics will be able to work comfortably around the engines, without being exposed to a cold blast of air.

The weight of the *DU-X* empty will be about 20 tons, and it will carry a useful load of fuel, oil, passengers, crew, and baggage of another 30 tons, so that the total gross weight will be about 100,000 pounds. The structure has been designed with extraordinary care and will be entirely of steel and duralumin. The performance estimate is that the maximum speed will be close to 200 miles an hour (this seems unduly high) and the endurance over 20 hours of flight. Any eight of the engines will suffice to keep the giant aloft as long as fuel is available.

The *DU-X* cannot equal the luxury of a modern liner, but it will have very comfortable passenger accommodations nevertheless. The hull will be 130 feet long and wide enough in the cabin for a row of six chairs separated by two aisles. There will be four passenger cabins for the 50 or 60 passengers carried. The kitchen is to be amply supplied with varied foods, and provide facilities for the most exacting cuisine. There will be separate compartments for the navigators, pilots, radio operators, and the rest of the crew. Dornier claims that the *DU-X* will be able to outride waves 15 feet in height, and that the wing structure will be able to withstand pounding just as long as the hull itself.

There is nothing unrealizable in this project. The trial trip will be awaited with interest throughout the world.

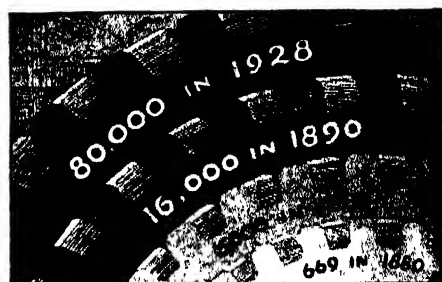
Guiding the Air-Traveler

RECENTLY the Airways Marking Conference met at Wichita, Kansas, to consider ways and means of marking our national airways. A new airway marker called "Aerovane," developed by the Aerovane Utilities Corporation of New York, received instant approval, and is now being installed throughout the country, on the outskirts of many municipalities.

The new airway marker consists of a structural steel pole, six inches in diameter and twenty-five feet in height. Three feet above the steel pole, at the very end of the marker is mounted a wind-cone, or "wind-sock" as pilots prefer to call it. Six feet below the point of attachment of the wind-sock is a large arrow, some 13½ feet in length and perhaps three feet in width. This arrow, painted a chrome yellow, has lettered in black the name of the town to which the arrow is pointing. On the tail of the arrow is placed a smaller arrow, painted in white and pointing toward the true north.

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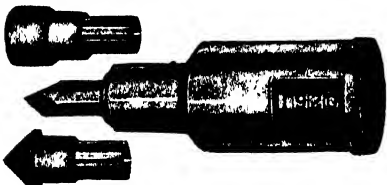
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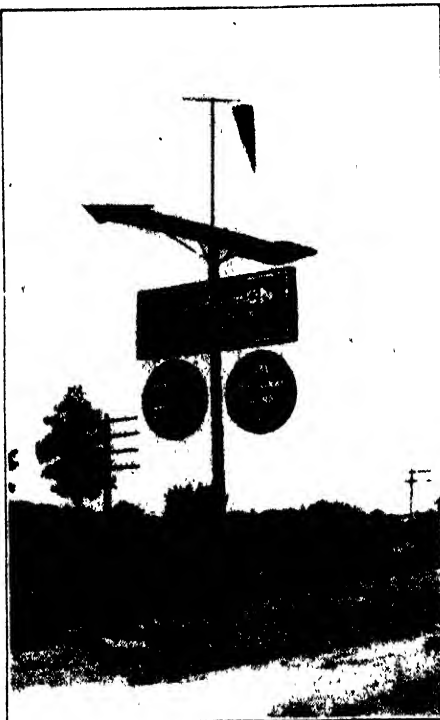
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board, usually eight feet by three feet, carrying the name of the town and perhaps its slogan. Hanging from this board on each side of the pole are circular panels, 42 inches in diameter, which can be rented for advertising purposes.

It is claimed that the arrow can be readily seen, under normal weather conditions, at a height of 3000 feet, and that the lettering designating the town or city is readable at a height of 1000 feet. Provision has also been made for flood-lighting the arrow when desired.

Such a marker has many advantages over random signs placed on the roofs of buildings which may or may not be located with reference to an airway. Safety in aviation depends as much on the provision of such aids as on the flying equipment and



The new airway marker as seen from the ground. At the top is a wind-sock, and below it is an arrow painted with the name of the town

personnel, and it is to be hoped that this marker or similar markers may soon be provided everywhere.

Modern Airports

LIEUTENANT DONALD DUKE is the author of the well-known book "Airports and Airways" and was formerly chief of the Airways Section of the Army Air Corps. His views on the modernization of our airports, expressed in an article in *Air Travel News* are therefore worth serious consideration. Our airports have grown up in somewhat haphazard fashion from the old type landing field, surrounded with a number of hangars whose sole facilities were shelter for the airplane. They had large swinging doors to provide entrance and exit for the planes.

If the public is to be permanently attracted to flying, the airport and the airport hangar must be made convenient and attractive. Municipal airports throughout the United States have abandoned the practice of erecting hangars on their properties, and quite rightly so, since this meant an additional burden on the taxpayer. They now lease hangar sites to the operators. Unfortunately, in such leases, uniformity of

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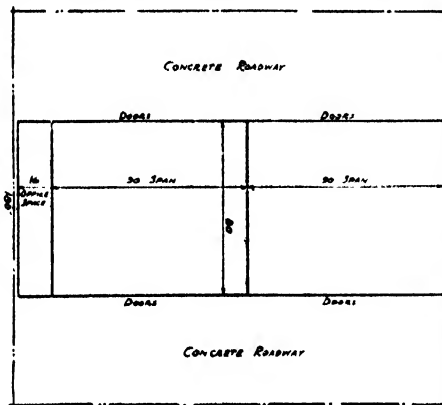
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construction and a certain level of utility and appearance have not been required. Hence the sad experience of many cities in seeing an ill assorted, incommensurable group of sheds disfigure their airport.

In the appended sketches, Lieutenant Duke sets forth his valuable ideas of what hangars and hangar arrangements should be. The hangar should have a front of brick-facing with windows resembling a modern store in appearance. It may be built in single units of 90 foot span, or in double units depending on the needs of the operating organization. Sufficient light should be provided through doors along the sides of the hangar. Steel or wood trussing, adequate ceiling so that heating is possible, and proper drainage are other requirements.

Between hangars of this type there should be a 100 foot concrete apron where planes may be warmed up and adjustments made.



Plot plan showing the proposed size of leased areas. Scale 1"=30'



Suggested floor plan for hangar office. Scale 1/4"=1'-0"



Office elevation. Scale 1/4"=1'-0"

Plans for a modern hangar and airport offices. See text herewith

This apron affords shelter from wind, lessens the danger of damage to the propeller by the picking up of small stones, causes less noise, eliminates congestion on the flying field and generally improves matters.

The tracts of land leased to operators should be of ample size, say 180 feet by 200 feet. The entire front of each hangar, facing the flying field, should be partitioned off as shown on the plan to give the maximum convenience to patrons and operators alike. Glass windows in the front of the hangar, and roof gardens for summer use will add to the comfort and pleasure of patrons. Lieutenant Duke's views are eminently sound and much of the success of passenger transportation companies will depend on the airport and hangar facilities.

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Industries From Atoms

(Continued from page 454)

in many instances capable of extreme deformation. They must not be affected by mouth conditions nor should they oxidize greatly when molten, in red heat, or during soldering operations. In addition to physical specifications, color demands must be met. One firm alone manufactures 11,553 standard stock articles of precious metals, taking into consideration formulas, finenesses, grades, colors, gages, lengths, sizes and weights. If the special demands were taken into consideration the number would be in excess of 25,000.

The demand for dental golds has increased in direct ratio to the practice of dentistry. Contrary to general opinion, gold alloys are being used in increasing amounts, although in better dentistry they are concealed when possible. Dental gold sales amount to at least 25,000,000 dollars annually. If the value of gold used in a restoration amounts to a dollar, the dentist's fee for his materials and time amounts to at least ten dollars. Thus dental fees for gold work alone total at least 250,000,000 dollars annually.

Trichlorethylene Finds Wide Application

PROMINENT among the newer solvents which are daily replacing the older solvents in new industrial applications is trichlorethylene, CHCl_3 . It is a pleasant-smelling liquid of 1.47 specific gravity and boiling point of 87 degrees, Centigrade.

Trichlorethylene does not attack the common metals even in the presence of moisture, and there is no difficulty in constructing equipment for its use at a reasonable cost. It is a very rapid worker, and may be used for the extraction of either moist or dry materials. In comparison with benzine, in the same apparatus, it yields a larger output in a given time. It is non-inflammable and has a low latent heat of evaporation. It is heavier than water, and therefore may be kept under water to prevent evaporation.

Trichlorethylene is used to-day in large quantities in the extraction industry. Its purity makes possible the extraction of delicate fats without damage. It is also largely used for de-greasing. It is used for the solution of resins, tarry and bituminous products, India rubber and many organic substances, sulphur and phosphorus; in the preparation of rubber-cements; and in the varnish, paint and lacquer industry.

Its valuable cleansing properties have led to its extensive use for dry-cleaning, where its non-inflammability is greatly appreciated; also to its incorporation with soap in laundry and scouring preparations.

Chemist Combats Corrosion of Collapsible tubes

COLLAPSIBLE metal tubes are used in almost incredible numbers as containers for retail quantities of tooth paste, cold cream, shaving cream, and medicinal or cosmetic preparations in great variety. Many of these preparations are alkaline and must be packed in tubes of greater chemical resistance than aluminum. Lead and tin are extensively used, but these metals are heavy in comparison with aluminum—a pound makes fewer tubes, and

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tin costs much more than aluminum per pound.

The average person would not think of shaving cream as a sufficiently corrosive material to destroy an aluminum tube, but, at least as far as those brands which consist principally of soap are concerned, such is the case. Manufacturers have discovered, however, that the addition of small amounts of sodium silicate to the shaving cream prevents this objectionable action, without affecting the quality of the product.

Silicate P's and Q's speculates on the cause of this protective action of silicates in toilet preparations. "This idea of a protective film is not supported by anything we have been able to see on the protected metal and it would also seem necessary in order to form the film that the contents of the tube should have a mobility which shaving cream does not possess. It seems to us rather more likely that the colloidal silica lays hold of the alkali in a way to render it less active, and that the effect is thus a general one which comes into play when the product is in use as well as when it is in storage."

Propane and Butane Used to Enrich Manufactured Gas

CONSIDERABLE interest is being evidenced by the gas industry in the possibility of using propane and butane gases as enriching agents in the carburetion of water gas. Propane and butane are obtained in large quantities as by-products in the production of natural gas gasoline, and can be liquified and shipped in pressure cylinders.

Tests that have been made show that this proposal is technically sound. In fact, there are many advantages claimed for it over the present method of enriching water gas by the use of oil. These advantages include a decrease in the consumption of enricher per unit of gas due to lower condensation in the distribution system, decreased purifying costs, saving in the expense of carburetors and superheaters, and fewer complaints due to obstructions in the lines caused by the deposition of naphthalene.

An editorial writer in *Gas Age-Record* says that the big question seems to be whether the price to be charged for propane and butane will allow its economical application to gas manufacture. If it is not used in gas plants, he points out, it probably will be used as a competitor of manufactured gas, particularly in industrial utilization.

Aluminum Plating Successful At Last

SUCCESSFUL electro-deposition of aluminum on metal, long a problem for science, has been perfected by D. B. Keyes of the University of Illinois. By means of this aluminum plating, billions of dollars may be saved, he predicted before the Institute of Chemistry recently.

"The housewife," said Professor Keyes, "will now be able to have her kitchen utensils look like the old aluminum variety and yet have the strength of steel. They will be cheaper and will have none of the disadvantages of denting and knicking which now are so common."

"In the production of power there is a large loss in the discard of 'economizer tubes' which can be avoided by using aluminum-coated steel, hitherto an impossibility."

"Even in the making of the locomotive this new process will bring considerable

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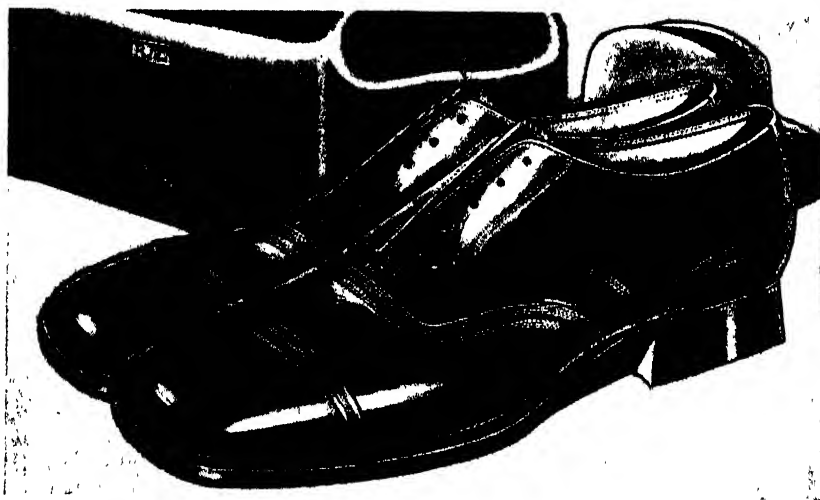
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"Pure aluminum will withstand the corrosive action of most concentrated acids and all common sulfur compounds but it has very little tensile strength or elasticity. This prevents its use as a structural material in spite of its light weight. The aluminum alloys are superior in these properties, but will not stand corrosive agents. It therefore becomes necessary to apply a thin continuous coat of aluminum free from holes to steel and other metals.

"This has been done at the University of Illinois by a new and different method of electro-plating. It is impossible to electro-deposit aluminum from a water solution. The new method makes use of organic metallic complexes that are liquid at ordinary temperatures or at temperatures slightly above."

Professor Keyes expressed the belief that this new method will have universal application to all metals. "It should be possible," he said, "to electro-deposit any metal desired, even though it is impossible by the old technique."

New Ford Contains 110 Rubber Parts

SINCE "Henry made a lady out of Lizzie," the once familiar nickname "Tin Lizzie" has fallen to the discard. The country certainly needs a new nickname to embody the affection, admiration and amusement which Model A is bound to inspire before its course is also run. Possibly the ingenuity of rubber technologists in developing their product to suit a myriad uses in the new Ford will eventually inspire a nickname in which rubber replaces "tin," for there are a hundred and ten rubber parts in the Model A Ford. A great many of these function solely to protect the car and its occupants against the action and noise of road shocks and power vibration.

Wherever there is a possibility of a squeak developing, where frame members are joined, or where the body is attached to the frame, rubber anti-squeak parts have been designed and installed. Engine mountings of the car are cushioned in rubber and the following parts each have an anti-rattler device of rubber: spare wheel carrier support; steering column support; steering gear control rod; gas tank cable support; carburetor adjusting rod on the dash board and the front belt rail.

The windshield, windows and doors are fitted with rubber weatherstrips to keep out driving rain and wind and the entire ignition system is insulated with rubber. The steering wheel is finished in hard rubber, which is also utilized in the manufacture of a number of the parts. Fordite, used in the door bumpers and other parts, is a high grade rubber composition material.

Straw, Formerly Burned, Becomes Basis of New Industry

SHOW the chemical engineer something that is going to waste and he will not sleep soundly until he has figured out some way to produce a valuable product from the refuse. Such was the inspiration for a straw insulating board which has come into wide and increasing use for building construction as an outside sheathing, a substitute for plaster lath, et cetera.

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every year because it is too resistant to decay to be assimilated by the soil between harvest and sowing time.

Since most cereal areas are devoid of forests and must transport lumber from distant places, it occurred to him that the straw might be made into boards. The fibers of straw are cemented together by Nature in long filaments which can be separated, after softening the binding material, by cooking for a few hours.

That portion of the straw which is rendered soluble by the digestion acts as a strong binder and water-proofing agent, so that the macerated fiber has excellent felting properties together with the cementing characteristics necessary to form a strongly interwoven mass. The proportion of air cells in the finished straw board is high so that the board weighs only 600 pounds per thousand square feet; since the board is seven-sixteenths of an inch thick this is equivalent to 16½ pounds per cubic foot as compared with eastern white pine which weighs 24 pounds per cubic foot.

More recently additional research work has pointed the way to the production of valuable by-products from the liquor from the digestion operation. These liquors are susceptible to bacterial action and, under proper control, acetic acid, lactic acid, various alcohols, and similar products may be obtained by fermentation.

Golden-rod Not to be Sneezed At

VICTIMS of hay fever may be excused for not attaching appropriate dignity to the lowly golden-rod as the official floral symbol of this country. This abundant wild flower bids fair to assume new dignity, however, as the result of Thomas A. Edison's researches on his private farm in Fort Myers, Florida. In his efforts to find among the wild plants of the United States a source of rubber, he has sown the seeds of 1400 wild plants. So far 80 of these have been found to contain rubber. At least 12 have been found to grow on the cotton plantations of the south without danger of harm from frost. Golden-rod, which will grow on the soil of almost every state, has been found to be one of the best sources of rubber among native wild plants.

Converting an Evil Smell to Dollars

IN a paper presented before a recent meeting of the Canadian Engineering Institute, W. H. DeBlois disclosed interesting statistics on the amount of sulfur contained in gases discharged in smelting plants of the Dominion. According to him, 1500 tons of sulfur are going to waste each day from Canadian smelters. The possibility of recovering a part of this for commercial use is of particular interest to Canada with its import balance of approximately 200,000 tons of sulfur valued at \$3,000,000 per year.

The imported sulfur is used largely by the pulp and paper mills. It is now proposed to produce liquefied sulfur dioxide at the smelters for use in the paper mills. According to Mr. DeBlois, the first effort to recover any of the sulfur from these gases was made by the Mond Nickel Company at its Coniston, Ontario, plant, where the recovered sulfur was intended for use in the manufacture of sulfuric acid. The attempt was a technical success, but no market was nearby for the acid produced, so the tendency lately has been toward the liquefaction of the sulfur dioxide.

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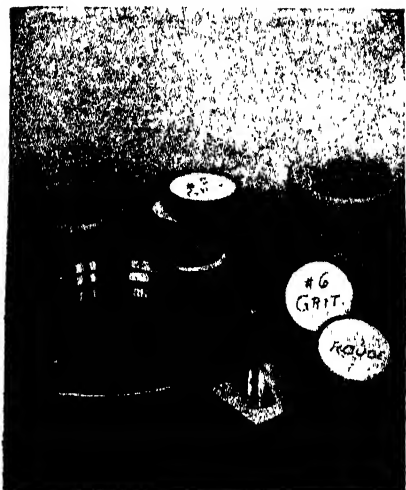
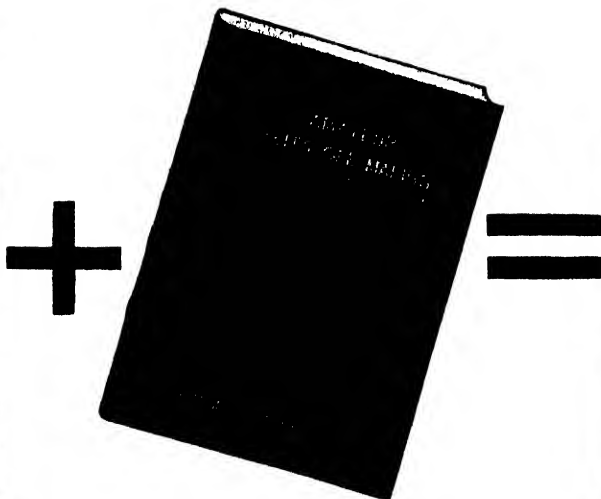
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Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

The Court Learns About Hooks and Slices

COURTS of law and equity have done some remarkable things. Under certain circumstances they have told a man how much money he was going to get, whether he was going to continue being married or not, and where he was going to spend the next few years; they even have been known to predict the date of a man's death.

Up to now, however, they have not ventured to explain why an average amateur golf player does not hit a ball better than he does. That was something that seemed beyond even the powers of a Federal judge to fathom. But in a patent case the queerest sort of things are likely to develop, so when Arthur F. Knight and the Horton Manufacturing Company sued the Union Hardware Company for infringement, Judge Thomas of the United States District Court for Connecticut found out the whole secret.

Knight is the man who invented and patented, in 1910, the steel shaft golf club which is in such wide and growing use today. He also owns seven eighths of the Horton Manufacturing Company, of Bristol, Connecticut, which, as the sole licensee under the patent, manufactures the shafts. Naturally, when the Union Hardware Company began to make and sell steel shafts, there was a suit for infringement.

Prior to his invention, Knight declared, golf clubs were constructed by securing the head of the club to a wooden shaft, usually of a highly elastic wood such as selected seasoned hickory, tapering to a comparatively small section near the head and much stouter at the handle end. Hickory has been uniformly preferred because it is hard, tough and supple, the suppleness controlling the rebound of the head after impact with the ball and adding to the distance of the drive.

"The patentee claims to have discovered that there is an inherent objection in a hickory shaft," says Judge Thomas, "because the wood is fibrous in nature and, therefore, offers but slight resistance to torsional strain, in consequence of which the head of the club yields in a line circumferential to the axis of the shaft, or, in other words, the blow produces a strong torsional strain, which twists the hickory shaft. This torsional element is alleged to be highly objectionable since an angular rebound causes the ball to deviate from the direction of impact, so that, unless the golf player knows how to offset this inherent tendency of the club, his play will be uncertain and irregular."

"In order to overcome this tendency or defect, the patentee seeks to provide a construction which is practically torsionless by making the shaft of steel tubing, preferably, hardened and tempered to give as great suppleness as desired. The tubing as described in the specification may be cylindrical, although a tapered or stepped tube is preferred. The patentee furthermore states that high carbon steel is preferred in making the tube and that it may

be tempered so as to increase the resistance to torsional strain. The tube may be case-hardened with improved results, or nickel steel may be used, the latter being known to be of high torsional resistance."

The court shows that golf clubs with metal shafts were known long before Knight entered the field. He cites the Grant British patent issued in 1892, describing "a golf club shaft made of steel or other elastic metal, either hollow or solid, or partly hollow and partly solid." He also cites the Hornsbrough British patent of 1894 covering a tapered steel shaft and the Bullows British patent of 1896 for a tubular metal shaft.

"Of course it must be held," Judge Thomas continues, dismissing the suit, "that the patentee was the first to provide a torsionless or substantially torsionless tubular metal shaft or golf club in order to enable a player to make his game more uniform and with which even a beginner may learn to play golf fairly well, so that the claims in suit are valid if read with the



Sometimes inventors are ahead of the times. Edward Lauste, shown above, may have been one of these. An early experimenter in the field of "talking motion pictures," he lacked capital to exploit his inventions. His patents expired soon after the World War. Now the art has caught up with him, but he has no rights from which to profit

limitations imposed upon them by the patentee who responded to the Patent Office rejection by stating that the claims 'cover a torsionless structure of steel tubing,' without which limitation the patent could not have been issued. But they are not valid without these limitations or if it is attempted to broaden their scope so as to include any tubular metallic shaft. The limitations read into the claim make them valid, but in such case the defendant does not infringe the claims in suit because

defendant's shaft possesses torsionless characteristics."

So now you know why it is you have not been able to play better golf.

Lincoln and Invention

INVENTIONS and patents have claimed the close attention of nearly every American whom history acclaims as great—Washington, Franklin, Jefferson—all the leaders of the past. Take Abraham Lincoln for example.

On May 22, 1849, Patent Number 6469 was issued to Lincoln on a device for buoying river boats over shoals, according to Joseph Rossman, Assistant Examiner in the Patent Office. The invention provided adjustable buoyant air chambers, with metal tops and bottoms, and the sides made of India-rubber cloth or other waterproof fabric. A number of them were placed at each side of the boat, and they could be raised or lowered by a series of ropes and pulleys. When the chambers were lowered and filled with air they expanded and buoyed up the boat and enabled it to float off the sand bar.

The entire specification of the patent, on blue-gray paper, is in Lincoln's own handwriting, although he used a printed blank form for the petition and oath, sworn to before a Washington justice of the peace. Although Lincoln himself was a good lawyer, he retained a patent attorney, Z. C. Robbins, to prosecute the application. Robbins amended the single claim of the application once before it went to issue. A model, now on exhibition in the National Museum, accompanied the application, as well as the fee of 30 dollars. Lincoln was a practical man, and the fact that he went to the time, trouble and expense necessary in developing his idea indicates that he probably expected something to come of it.

Ten years later he still was interested in inventions. His funds being low, he tried lecturing and chose "Discoveries and Inventions" for his subject. This lecture he delivered in Springfield, Illinois. It first appeared in print, however, in the *Sunset Magazine* in 1909.

"Man is not the only animal who labors," he told his hearers, "but he is the only one who improves his workmanship. This improvement he effects by discoveries and inventions. His first important discovery was the fact that he was naked; and his first invention was the fig-leaf apron. This simple article, the apron, made of leaves, seems to have been the origin of clothing—the one thing for which nearly half of the toil and care of the human race has ever since been expended."

Throughout his career inventions interested him. When he was President, Christopher N. Spencer, inventor of the first repeating rifle, brought one of his rifles to Washington. He explained its operation to Lincoln, and the next day Lincoln and Spencer walked to the spot where the Washington Monument now stands and set up a target. Lincoln made several good shots and found the new rifle satisfactory.

Through his influence about 10,000 were ordered. About 20,000 altogether were issued to the Union Army, and they proved effective in a number of important battles including Gettysburg.

When John Ericsson submitted his plans for the *Monitor* to the Union admirals, they were not favorably received. It was only when Lincoln exerted pressure that the freak invention was accepted. The *Monitor's* saving of the remnants of the Federal fleet is a matter of history. Once again Lincoln had justified his interest in inventions.

Jacks for Queens

THE birth of invention is the death of chivalry. If the Queen of England today found a muddy gutter facing her, there would be no need for a Raleigh to spread his cloak. The Queen would be wearing galoshes.

There has been one situation, however, where traveling gallants have been wont to aid queens on the road. This occurs where a lady motorist has a flat tire and tries in vain to jack her car up so the tire may be changed. It is a messy job and no lady likes to do it.

Now, however, in France, an automatic jack operated from the instrument board of the automobile has been perfected, according to advices received by the Automotive Division of the Department of Commerce. A jack for each wheel is situated on the axle. It is a short steel cylinder, the lower part of which normally is level with the jack block and the axle, so as not to decrease the road clearance. A double telescopic piston in the cylinder allows a relatively long stroke for the lifting plate. All milady does is push a button on the instrument board, the block descends to the ground, and the wheel is lifted.

Thus do inventions add to women's independence.

Commercial Prints and Labels

AS one item of its service, the Ervin Press Corporation cleans neckties. As a means of calling attention to this service, it has devised a print comprising a diamond-shaped outline within which are several business slogans or advertisements including, "Did you ever have your ties cleaned? They come back with all their original respectability, 15 cents each." A pictorial representation of several ties appears on the print.

This print they sought to register in the Patent Office, calling attention to the provision of the copyright statute which reads, "No prints or labels designed to be used for any other articles of manufacture shall be entered under the copyright law, but may be registered in the Patent Office." This clause, they urged, should be interpreted as meaning that the print or label itself may be regarded as the article of manufacture contemplated by the Act.

It was no use. Assistant Commissioner Kinnan denied registration, saying, "This section of the copyright law was enacted as long ago as 1874 and for almost a third of a century has been consistently construed by the various officials of this office as requiring that the print shall be designed for an article of manufacture other than the print itself and other than those 'connected with the fine arts.'"

"While the construction heretofore placed on the law relating to registration of prints

would not preclude a different view in the instant case if clear error were made to appear in such former construction, yet the fact that such interpretation has been uniformly followed for this long period during which the statute has been in force is persuasive that such view is correct.

"The applicant contends that its print describes neckties, but with this contention I am unable to agree. The print is clearly an advertisement of service and the conclusion of the examiner as to this point is believed to be sound."

Trademarks in China

THE Republic of China, with four hundred million inhabitants and far too few manufacturers to begin to supply them, offers an attractive market for American exporters. Success, however, depends in no small measure on knowing the tastes, ideas and habits peculiar to the Chinese. Only one tenth of the Chinese can read; the others buy goods through recognizing some particular "chop" or trademark. It is important, therefore, Dr. Julius Klein, Director of Foreign and Domestic Commerce points out, that trademarks for use in China be chosen intelligently.

"If your trademark features the picture of a dog, you will do well to change it in China, for the dog, to put it mildly, has no high place in Chinese regard. Still worse

would be the error of a manufacturer who stamped a rabbit on his wares, and if by chance he should choose the turtle, inoffensive enough to our western ideas, his product would be condemned at a glance.

"One American canned-milk company, in its China advertising," he says, "made the mistake of emphasizing the use of its product with coffee and tea, although the Chinese know nothing about coffee and would no more think of putting milk or cream in their tea than Americans would think of putting it in lemonade. Another American milk company made a big hit with the Chinese by showing in its trademark an infant labeled 'It's a Boy' thus appealing to the universal desire for, and pride in, a son.

Dr. Klein mentioned several instances in which large markets have developed in China from unexpected causes. An American manufacturer noted that there was an extraordinarily large sale in China for the small hot-water bags usually known as "neuralgia bags." Chinese girls were buying these to use as hand warmers in their muffs, and to hold against their faces to give them red cheeks.

New Uses for Old Methods

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Patents Recently Issued

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Pertaining to Aeronautics

AEROPLANE LANDING AND LAUNCHING DEVICE—Primarily designed for landing and launching aeroplanes in comparatively congested areas, the planes being landed and launched without touching the ground. Patent 1680473. O. Parker, Bentonville, Ark.

HELICOPTER—Can be operated to rise from the ground and descend in a substantially vertical direction, may be propelled at relatively great speed, and accurately controlled. Patent 1681019. H. C. Stewart, Webster, Ky.

Pertaining to Apparel

ARTICLE OF HEADWARE—A cap, in which is embodied an outer band forming a finish for the crown, at its edge, and at the same time a head-contacting size band. Patent 1681006. P. Merton, Park Ridge, N. J.

Chemical Processes

METHOD OF PREPARING RUST-RESISTING IRON AND STEEL PRINTING PLATES—For readily receiving the photographic, or transfer coating, in lithographic work, by washing one surface with a 10% solution of hydrofluoric acid, washing off the acid, and thoroughly drying. Patent 1681849. R. Fritsche, 188 Centre St., New York, N. Y.

Designs

DESIGN FOR AN ELECTRIC-LIGHT FIXTURE—Patent 76140. W. Klehr, c/o E. F. Caldwell & Co., 36 W. 15th St., New York, N. Y.

DESIGN FOR A DRESS—Patent 76121. Katherine E. Burns, c/o Franklin Simon & Co., 38th St. & 5th Ave., New York, N. Y.

DESIGN FOR A VENTILATED RODENTPROOF CLOTHES HAMPER—Patent 76017. M. Halpert, c/o M. H. Metal Product Corp., 1154 Flushing Ave., Brooklyn, N. Y.

DESIGN FOR A STOCKING—Patent 76025. R. Lefi, c/o Lefi & Co., 305 5th Ave., New York, N. Y.

DESIGN FOR A TEXTILE FABRIC—Patent 76029. W. H. Mayer, Jr., 260 Green St., New York, N. Y.

DESIGN FOR A RADIOCABINET—Patent 76185. O. P. Fritchle, 4618 Kanmore Ave., Chicago, Ill.

Electrical Devices

CUT-OUT AND PLUG—Wherein a special structure will prevent anything but a correct fuse plug from being used, when plugs are changed or new ones provided. Patent 1680969. W. P. Briggs, Municipal Bldg., New Bedford, Mass.

GROUND FITTING—For use in connection with

polarized service, for grounding the neutral, or so-called white wire, on a water pipe or the like, without solder or adjusting straps. Patent 1681129. A. M. Nugent, Unionville, N. Y.

POWER-FACTOR CONTROL FOR POWER SYSTEM—Whereby the power factor of an alternating current power system having a synchronous motor load may be maintained at unity or 100%, with automatic regulating means whereby the above advantages may be accomplished. The inventor has been granted two patents, 1681004 and 1681005. S. Melton, Sturgis, Ky.

THERMOSTATIC CONTROL—For an electric circuit, with electro-magnetic means for opening and closing the circuit in combination with a thermostat, rendering the electro-magnetic means active under predetermined conditions. Patent 1681446. R. S. Tice, Monterey, Calif.

Of Interest to Farmers

POULTRY FEEDING AND WATERING DEVICE—Which provides an ample supply of food and water eliminating repeated feeding, and includes means for periodically flushing the water supply. Patent 1682614. H. V. Guertin, 32 Conklin Ave., Patchogue, L. I., N. Y.

Of General Interest

DRAINAGE DEVICE FOR WINDOW SCREENS—Whereby the rain or moisture forced through the screen will drain out to the exterior of the window frame. Patent 1681846. C. C. Engelbart, 721 Second Ave., Rochester, N. Y.

DEVICE FOR USE IN WRITING—An adjustable sliding tube and rings for correcting handwriting, and to insure that the pen or pencil is held in the correct position. Patent 1681842. D. Collen, c/o Canadian Pac. Express Co., Dryden, Ont., Canada.

ARTIFICIALLY-HEMSTITCHED FABRIC—Which simulates hemstitching by the use of black threads woven through the fabric, may be applied to towels, pillow cases, table cloths and other articles. Patent 1681827. F. Tausend, 114 Franklin St., New York, N. Y.

PROTECTIVE CAP FOR WOOD PILING—Which may be conveniently applied to any pile head for preventing rain water from collecting on the top and rotting the wood. Patent 1681857. J. Jacobson, 2311½ Ave. "C," Galveston, Texas.

OPTICAL DEVICE—Including a mirror which may be positioned relative to the eye, while using the thumb and finger of the hand to open the eye, and the other hand to remove foreign objects. Patent 1681874. A. F. Ouellet, c/o Tech. Lab. Corp., 693 Broadway, New York, N. Y.

SMOKERS' RECEPTACLE—A combined movable ash-tray, and dispensing container for cigars, cigarettes or the like, the tray constituting a supporting base for the container. Patent 1681852. W. I. Goscener, 483 Jersey Ave., Jersey City, N. J.

TOWEL DISPENSING AND STORAGE CABINET—Adapted to provide ample storage space for all the necessities of the toilet, such as paper towels, toilet paper, liquid soap, brushes, and disinfectants. Patent 1681840. A. E. Carlson, c/o Nevis Public School, Nevis, Minn.

POST—A device adapted to be fitted over the backs of chairs so that the tops are hidden and they present a solid row, such as a pew. Patent 1681020. J. F. Stimson, Lenoir, N. C.

GAS CONTROL—A valve which will automatically cut off the flow of gas in a house when the service line is under repair. The device may be manually reset. Patent 1681041. C. E. Kimbrough, Box 922, Haynesville, La.

ently, all that is necessary is to use an ordinary screw hook, inserting the screw portion through an opening in the lining and screwing it into the wooden casing beyond. In fact, that is the way refrigerator manufacturers used to do it before W. H. Whittier took out his two patents, one in 1910 and one in 1915.

There were difficulties with this practice, however, due to the rigidity of attachment between the lining and the case and the contraction and expansion to which the lining was subjected by temperature changes. The lining also had a tendency to warp in the process of baking the porcelain coating, and where the lining bulged inwardly at the opening left for the shell support, a greatly increased pressure was often necessary to affix it. This meant a tendency of the porcelain to chip.

Whittier's method, the patents for which were acquired by the Grand Rapids Refrigerator Company, avoided these difficulties. He attached the shelf supports to the lining before the lining was placed in the case. He rotated the bolt or threaded portion of the support, while that carrying the washer and in contact with the porcelain he held immovable during attachment. Thus he eliminated all stress and strain due both to attaching the shelf support and to temperature changes. There is no doubt that the method was a good one.

When the Grand Rapids Company came to sue Stevens and others for infringement, however, it ran into difficulties. The Federal District Court for Eastern Michigan declared the patent claims invalid for want of invention, and the Circuit Court of Appeals has upheld the decision. Judge Hickenlooper says:

"We are convinced that in the adoption of the specific shelf support of the claims in issue, the patentee exercised no more than a high degree of mechanical ability and power of selection. It may well be that the enumerated advantages of the use of this device in connection with enameled or porcelain coated metal had not theretofore been recognized, but the device itself is old, and as described in the patent, operates in a manner identical with the devices of the prior art. The use of the shelf support of the patent is only a new or enlarged use of an old device. Such discovery of new uses for or newly observed functions of a device well known in the mechanical or structural arts is not a patentable invention."

Trademarks in the Philippines

V. ALDANESE, Insular Collector of Customs for the Philippine Islands, has issued the following circular letter to all manufacturers, importers and others concerned:

"In connection with the registration of trademarks in all ports of entry in the Philippine Islands as prescribed by Customs Administrative Order Number 194, it is hereby announced that, in pursuance of an opinion of the Attorney-General rendered on July 25, 1928, United States trademarks registered in the United States Patent Office and recorded in this Bureau must also be registered in the Bureau of Commerce and Industry, Manila, Philippine Islands, in order to be entitled to the protection accorded by Act Number 2460 and to enable the owners thereof to sue for damages for any violation of their rights to such trademarks, under the provisions of Act Number 666, as amended by Act Number 3332."

OIL-STORAGE TANK—Adapted for containing oils of different specific gravities from crude oil to gasoline, and means for preventing, or minimizing, the losses by evaporation. Patent 1681098. M. O. Clark, c/o Standard Oil Co., Hong Kong, China.

SMOOTHING-IRON PROTECTOR—In the nature of a wire or light metal basket attached to one end of an ironing board for holding a hot iron. Patent 1681128. M. A. Morse, Jr., 5521 Woodlawn Place, New Orleans, La.

COMBINED LIQUID CONTAINER AND SPRAYER—Which affords facilities for holding a liquid, and also has operable means to cause the liquid to be discharged in an atomized state. Patent 1680983. G. B. Graf and F. E. Whitman, 132 No. McKinley St., Shawnee, Okla.

CHECKING TAG—Which will serve to prevent fraud at the time of reclaiming the article checked, and will also prevent the re-use of the tag. Patent 1679699. A. E. and A. G. Wright, Casaloma, Apts., Pine & Mason Sts., San Francisco, Cal.

DIVING APPARATUS—Having means for the general improvement of the device and the renewal of the air, as well as to proportionately increase the inside pressure as the depth increases. Patent 1681029. C. J. Cooke, 33 "B" St., N. W., Washington, D. C.

SINK CLEANER—Which may be used optionally for cleaning or scraping the walls of a sink, or as a shovel for removing matter from the sink. Patent 1681082. H. Bamberger, 1693 Linden St., Brooklyn, N. Y.

COMBINED SCISSORS AND SHOE HORN—Which accomplishes the dual functions, without impairing the manual operations of the scissors, or the insertion of the feet into shoes, as with a conventional shoe-horn. Patent 1681691. O. Altenbach, c/o Roosevelt & O'Connor, 120 B'way., New York, N. Y.

WALL SAFE—A fireproof safe, which may be installed between the wall lathing, will present a finished surface, and may be easily concealed by a picture or wall ornament. Patent 1681290. E. E. Glass, 2759 Effie St., Los Angeles, Calif.

CLOTHESPIN—Which will effectively clamp itself to a clothes line and to clothes suspended therefrom and prevents the clothes from shifting. Patent 1681461. W. R. Butner, Box 108, Yerington, Nevada.

GRINDSTONE AND METHOD OF MAKING SAME—By mixing abradant particles with cement, allowing the mixture to set, crushing the same into coarse aggregate, and adding a second plastic mixture to fill all the voids. Patent 1682649. J. L. Weller, 294 Bay St., So. Hamilton, Ont., Canada.

GLAZING SYSTEM—More particularly intended for use in that class of buildings known as the steel skeleton type, whereby a more practical, and more weather-tight method is provided. Patent 1682291. L. Lane, P.O. Box 1066, Habana, Cuba.

TOASTER AND BROILER—Having rockable bread or meat-holding devices, and means to throw out the bread or meat, after a predetermined time for which the device is set. Patent 1682688. A. C. Parodi, 44½ Cottage St., Jersey City Heights, N. J.

PHOTOGRAPHIC FILM OR PLATE PACK—With means for simplifying and cheapening the arrangement by reducing the size of the backing sheets to substantially that of the film or plate. Patent 1682628. M. and J. Romanowicz, c/o Paget, Monller & Hardy, Reimergasse, 6 Vienna 1, Austria.

SADIRON RECEPTACLE—Adapted to be built in the wall of a room to provide a concealed housing for a sad iron when not in use, and even when heated, yet readily accessible. Patent

1681291. E. E. Glass, 2759 Effie St., Los Angeles, Calif.

Hardware and Tools

DOOR-HOLDING TOOL—For holding a door in both closed or open positions, with various positions between open and closed, including holding a door while mortising for a lock. Patent 1681834. A. A. Arends, R.F.D. Box 303B, Menlo Park, Calif.

WATCHMAKERS GAUGE—For ascertaining the dimensions and distance between an end and the shoulder of a balance staff in repairing watches where the staff has been broken. Patent 1681121. R. Larsen, c/o Arnold Green, 2500 Webb Ave., Bronx, N. Y.

TOOL JOINT LOCK—By which a drilling tool joint is automatically locked in coupled position against accidental uncoupling, yet capable of being unlocked when desired. Patent 1681699. J. C. Coates, 1003 East Virginia Terrace, Santa Paula, Calif.

CLAMP—Designed to clamp either a few or a great number of sheets, so as to hold them firmly in register while being cut or otherwise treated. Patent 1682604. H. G. Dishrow, c/o New York Trust Co., 100 Broadway, New York, N. Y.

Heating and Lighting

HEAT-CONDUCTIVITY APPARATUS—Which affords facilities for ascertaining the relative heat conductivity of any substance, the heat conductivity of common silver being taken as a standard. Patent 1680638. F. M. Rowan, Collins, Ga.

FLASH BOILER—Which is capable of producing in an economical and efficient manner a high steam pressure from a relatively small amount of water. Patent 1680608. A. G. Garbutt, Jessup, Ga.

OIL BURNER—Embodying a rotating spreader for the oil which minimizes the formation of carbon, and a motor for actuating a fan which supplies air to the burner. Patent 1682615. H. H. Holmes and A. F. Espersen, 520 Batavia Bank Bldg., La Crosse, Wis.

Machines and Mechanical Devices

POCKET SPACE STAMPING MACHINE—For holding in place a plurality of shirt fronts, together with means for successively stamping the fronts to indicate where the pockets are to be placed. Patent 1681882. J. F. Silverman, 5042 38th St., Brooklyn, N. Y.

MACHINE FOR CASTING STEREOTYPE PLATES HAVING A MOLD ADOPTED TO BE PRESSED AGAINST THE OUTLET OPENING OF THE POT—Which automatically controls the flow of metal from the pot to the casting pot without the parts coming out of engagement with each other. Patent 1681872. E. Muller, c/o Winkler Fallert & Co., Bern, Switzerland.

DISH WASHING STERILIZING AND DRYING MACHINE—Including a revolving trough with apertures for the dishes, and means for projecting jets of washing and rinsing water, withdrawing the water, and producing an air current for drying. Patent 1681839. J. L. Breton, c/o C. Blety, 2 Boulevard de Strasbourg, Paris, France.

COTTON-GIN-BREAST-ACTUATING DEVICE—A mechanism automatically latched to sustain the breast against falling, upon being actuated to elevated position, and thereby preventing

injury to workmen. Patent 1681837. T. M. Bruce, c/o Guthrie Cotton Oil Co., Guthrie, Okla.

KEY-ALIGNER—For accurately aligning concrete sheet pilings as they are driven into the ground, the key co-operating with grooves in the abutting edges of the pilings. Patent 1681858. J. Jacobson, 2311½ Ave. "C," Galveston, Texas.

PRINTING PRESS UNIT—Comprising two half-units, each having cylinders thereon, and means for driving the cylinders of each half independently, and in either the same, or opposed directions. Patent 1680018. W. H. Granger, c/o Duplex Printing Press Co., 323 De Young Bldg., San Francisco, Calif.

APPARATUS FOR DYEING YARN—Especially designed for permitting the dye or other liquid to be forced by pressure through the yarn, when it is wound on a perforated bobbin. Patent 1681088. L. Bounous, Valdeuse, N. C.

CLOTH-ROLLING MACHINE—Which rolls the cloth smoothly, and positively precludes the formation of wrinkles, where the cloth is subsequently to be sliced into narrow strips. Patent 1680979. P. Gardner, c/o H. M. Bunker Co., 56 Worth St., New York, N. Y.

BELT SCRAPER FOR TRACTORS—For cleaning the central portion of the treads and for dislodging the material adhering to the lugs, particularly adapted for use on snow covered land. Patent 1682623. J. Mosca, Box 83, Rouse, Colo.

WIND-CONTROLLED STEERING GEAR—In the form of a wind vane, by which the direction of the prevailing wind will control a sailing vessel, and keep it true to its course. Patent 1681415. H. A. Lee, c/o P. W. D. Sewa, Fiji Islands.

SAFETY HOOK—Having a latch which positively closes by gravity and prevents all danger of the hook catching in a derrick or other object, in hoisting machinery. Patent 1682617. W. G. and K. R. Jensen, c/o Jensen Mfg. Co., Nowata, Okla.

DISPENSING DEVICE—Which insures the sanitary discharge of a predetermined number of toothpicks, and prevents the handling of others than the ones taken for personal use. Patent 1682629. L. Rossi, 20 La Salle St., New York, N. Y.

Medical Devices

OIL SPRAY—Including a barrel, and a plunger connected exteriorly of the barrel, for applying the proper amount of oil for the treatment of any particular case. Patent 1680645. C. E. Sims, c/o Farmers and Bankers Life Ins. Co., Sweet Waters, Tex.

POCKET SPUTUM CUP—Constructed from a single sheet of material, with a closure flap formed to positively seal the cup against the escapement of the contents. Patent 1680151. J. Kauffman, 531 W. 179th St., New York, N. Y.

Plumbing and Fittings

CLEANABLE TRAP FOR SINKS AND THE LIKE—Which provides a straight pipe with readily accessible cleaning chambers, yet preventing all possibility of sewer gas backing up, and eliminates the gooseneck. Patent 1681117. H. A. W. Howcott, 720 Union St., New Orleans, La.

Prime Movers and Their Accessories

OIL PURIFIER—A device in which portions of the oil are heated to render them easily strained

and to free them from gasoline vapors before returning to the crank case. Patent 1680716. D. F. Zook, Hotel Monnett, Evanston, Ill.

Railways and Their Accessories

RAILROAD TIE—Constructed from a combination of wood and steel, having the advantages of a wooden tie, but requiring only a minimum amount of wood. Patent 1681115. E. E. Hendrickson and G. C. Dixon, 520 7th Ave., Watervliet, N. Y.

AUTOMATIC STOPPING SYSTEM FOR RAILROAD CARS—Characterized by the braking shoe being provided with two guiding devices whereof one is fixed and the other movable, while remaining parallel with the track. Patent 1681106. J. Farenc, c/o Office Pickard, 97 Rue St. Lazare, Paris, France.

RAIL-FASTENING DEVICE—Designed to be interposed between the spike and rail edge, and provides inclined forming wedges co-operating with the opposite edges of the spike to prevent creeping of the rail. Patent 1681049. H. H. Renfro, 412 Hammond St., Rocky Mount, N. C.

Pertaining to Recreation

STEAMBOAT AND LIKE TOY CONSTRUCTION AND PRINTED BLANK THEREFOR—Which will provide a toy by simply cutting out a sheet of material along printed lines, and bending along the lines to complete the object. Patent 1681878. F. E. Prince, 27 McKinley St., Bangor, Maine.

GAME—Wherein balls can be projected upwardly into a basket contained within a cage carrying out the idea of a basket ball game. Patent 1681682. L. S. McVey, Rulo, Neb.

GAME APPARATUS—Embodying a game board with targets corresponding to the bases on a baseball field, the targets being releasable only upon first striking a master target with a suitable projectile. Patent 1681693. F. W. Becker, 132 Wadsworth, Ocean Park, Calif.

TRIANGLE PAD—In the form of a table protector and cleaning device for balls, for use in racking the balls on a pocket billiard table. Patent 1682616. F. C. Irving, 632 73rd St., Brooklyn, N. Y.

Pertaining to Vehicles

ILLUMINATING LAMP FOR AUTOS—An extensible "trouble lamp" the various parts of which may be readily attached to the dash board and connected with the automobile electric system. Patent 1680508. V. S. Downing, West Jackson, P.O., Jackson, Miss.

INFLATION DEVICE—For automobile tires, in which the main air supply is connected with a gauge, enabling the user to read the pressure of the tube under inflation. Patent 1682625. E. J. Olsen, 7th & Margaret Sts., North St. Paul, Minn.

MATCH BOX HOLDER—Which is capable of being readily applied to the steering wheel of an automobile so as to be within convenient reach of the operator. Patent 1681710. R. M. Ostrander, 1276 No. Wilton Place, Los Angeles, Calif.

TRACTOR ATTACHMENT—For use in connection with trucks or other vehicles stuck in the mud or in a hole, and will function to propel onto solid ground. Patent 1682717. A. Corona, c/o N. Hirsch, 1819 Broadway, New York, N. Y.



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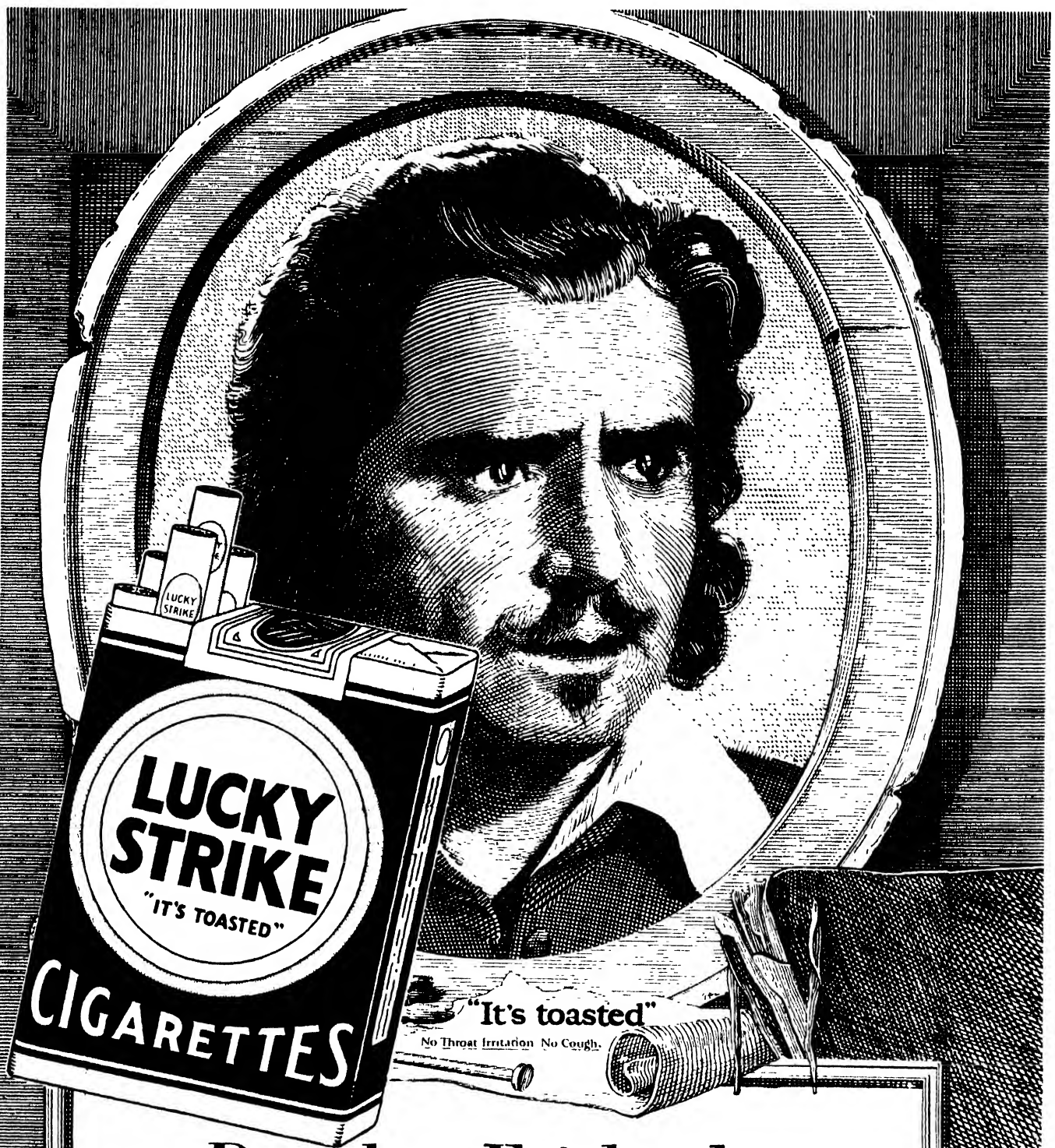
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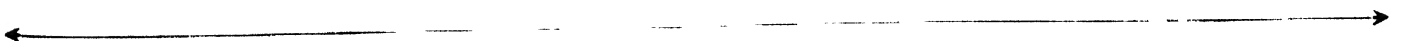
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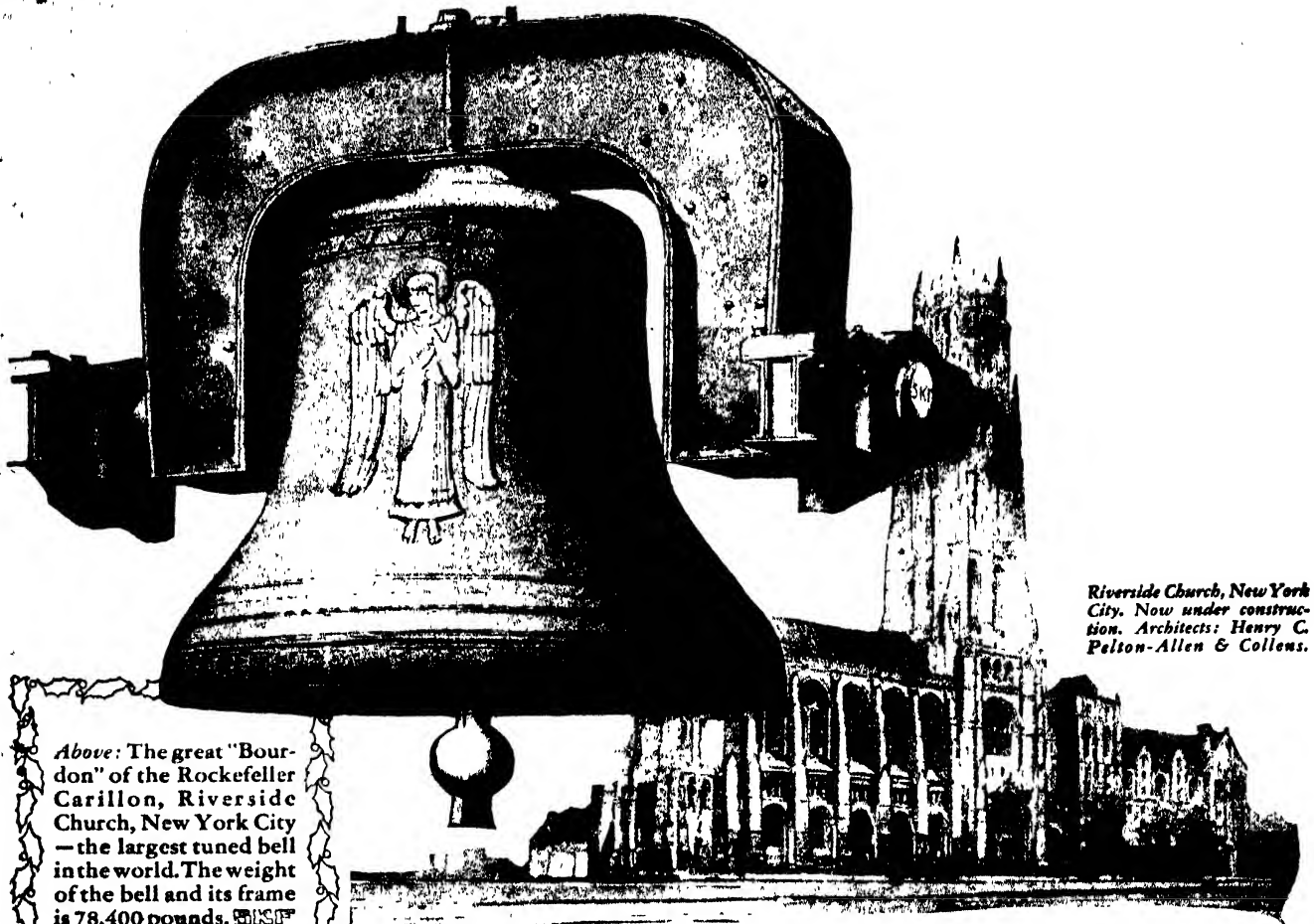
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Above: The great "Bourdon" of the Rockefeller Carillon, Riverside Church, New York City — the largest tuned bell in the world. The weight of the bell and its frame is 78,400 pounds. SKF Anti-Friction Bearings were selected for the main journals and for the clapper and counter-weight which in themselves weigh about one and one-half tons.

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SCIENTIFIC AMERICAN

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Eighty-fourth Year

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Looking Ahead With the Editor

Automobiles

DURING January at the annual Automobile Show in New York City the public will see for the first time the latest models of American cars. Apropos of the occasion, the January issue of *SCIENTIFIC AMERICAN* will contain a wide variety of automobile material which was released to us in advance for this purpose. Besides details of the new cars, this issue will include many items of great interest to car owners and others.

Eruptive Mountains

PROBABLY you do not realize that there are 66 active volcanoes in the world today. It's true. An article soon to be published describes some of the more famous of these, gives their histories, and tells how they have often upset the theories of volcanologists. Many interesting facts concerning their periods of inactivity, their eccentricities, and the materials they eject, are brought out in this study of a most fascinating subject.

Paper

IT has been said often that should some great cataclysm obliterate our civilization, future races would find but few records on which to base an estimate of our culture. We moderns use wood-pulp paper that rapidly deteriorates, whereas the ancients used clay and stone and the medieval scholars used parchment and rag paper, all of which last centuries. A forthcoming article about paper is well illustrated with photographs to show the decay of very new records.

What is Life?

AMATEUR chemists can duplicate the experiments performed by Professor Herrera and described in an article coming soon. Fascinating pseudo-cells, made of common chemical substances by him, display the non-living features of protoplasm. As a result of his studies of imitation cells, Professor Herrera believes that life is no phenomenon but a property which all matter possesses under the right conditions.

Do Animals Think?

BIOLOGISTS say "No." They use "spontaneity," "inherited propensity," and "mechanical automata" as words to explain the apparent cerebrations of animals. The author of an article on hand opposes these views. He believes that animals do think and cites examples in support of his theories. Frankly, no one knows definitely who is right but the discussion is an intensely interesting one and you will enjoy reading it.

Every Issue Fully Illustrated

Men are known by the magazines they read. What easier road to distinction could there be than reading the *SCIENTIFIC AMERICAN*—at four dollars a year?

Among Our Contributors

Alexander F. Skutch



Dr. Skutch, who contributes in this issue a very interesting article on the carnivorous plant called the bladderwort, is of the younger school of botanists of Johns Hopkins University. He has just completed a study of the anatomy of the banana, and expects to spend a year, during the period of the fellowship recently awarded him by Johns Hopkins University, in Central America engaged in a scientific study of the development of the banana leaf.

Earl E. Schumacher

Mr. Schumacher is a member of the technical staff of the famed Bell Telephone Laboratories in New York where many scientists work on a multitude of problems in pure and applied science. His work there has pertained to new alloys for cable sheathing, alloys for vacuum tubes, thermionic activity, and other very interesting problems.

Paul Griswold Howes

Mr. Howes is an assistant curator of a museum in Connecticut but he is the sort of man who is not satisfied unless he is exploring in his pet spot. In his case it is Dominica which he says he discovered "scientifically." On his own resources he has already made two fruitful trips there and now plans another. Scientifically exact in his methods, he includes in his articles a great deal that savors of romantic adventure.



E. L. Chicanot

From the versatile pen of Mr. Chicanot has come many fine studies of the economics of Canada. His article in this issue, concerning the future of the great northwestern territory above our border, will open the eyes of many as to the economic possibilities there.

James Henry Breasted

Professor Breasted has devoted most of his time since his early college days to the study of oriental languages and literature, has taught Egyptology and oriental subjects in American Universities, and has written much on these subjects. He is the Director of the famous Oriental Institute.

WESTERN INDUSTRIAL LEADERSHIP

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Charles M. Schwab

THAT opportunity in America is omnipresent is exemplified by the career of Charles M. Schwab who rose in 15 years from a dollar-a-day job to the position of president of what was then the greatest manufacturing corporation in America, later to that of president of a new and larger combine, and finally, to that of Chairman of the Board of Directors and controlling stockholder of the huge Bethlehem Steel Corporation. Born at Loretto, Pennsylvania, in 1862, he entered the Edgar Thomson Steel Works as a stake driver at a dollar a day. He studied machinery and men, became plant superintendent, and later

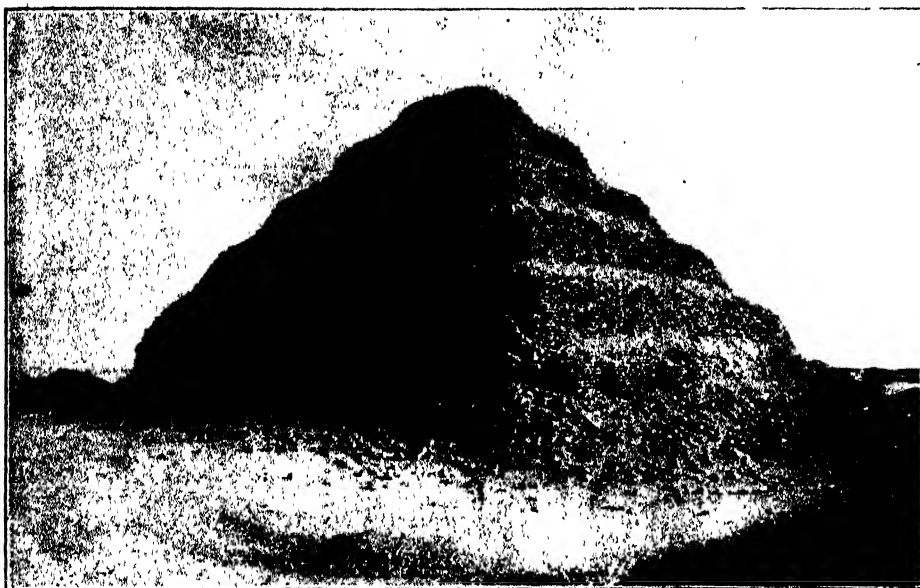
headed the engineering department of the Carnegie Company. His subsequent rise was rapid. He designed and supervised erection of the great Homestead Steel Works plant, a practically continuous mill in which the raw materials go in at one end and the finished products come out at the other. He also solved the problem of how to make more and better steel at a time when this subject was of great importance. During the war, he was Director-General of the Emergency Fleet Corporation. The Iron and Steel Institute of England awarded Mr. Schwab the Bessemer gold medal on May 3, 1928.



Copyright Fairchild Aerial Surveys

The Woolworth Building Seeks the Sun Above the Fog

Photographs of mountains above fogs have been made often. This one, however, of the Woolworth Tower rising majestically above a ground fog that enshrouded the surrounding buildings is extraordinary



THE OLDEST KNOWN MASONRY SUPERSTRUCTURE IN THE WORLD
Thirtieth Century B.C. The so-called "Terraced Pyramid" of Sakkara was erected by Grand Vizier Imhotep, founder of architecture in stone masonry and earliest physician known to history

The Oldest Known Surgical Treatise*

*Nearly 5000 Years Ago the Egyptians Had
Made Remarkable Advances in the Surgical
Treatment of Human Ills*

By JAMES HENRY BREASTED
Director of the Oriental Institute, University of Chicago

WHEN did man first begin to be aware of the mysteries of his own body, study its structure and investigate the nature of the extraordinary processes which it carries on? It has been said that astronomy is the oldest of sciences, and it is true that astronomy developed astonishingly early; but behind the beginnings of astronomy, mathematics and medicine, there were long stages of practical human experience which were gradually transformed into science, and it would be difficult to determine with certainty which was the earliest of the group.

IF we could decide the question on the basis of surviving treatises, then medicine and mathematics could claim priority, for we possess Egyptian treatises in these two fields which are considerably older than any surviving astronomical discussion; but such a decision is impossible, for all three of these sciences are much older than any surviving treatises.

As far back as the middle of the 28th Century B.C., we find Pharaoh Neferirkere going out into the royal cemetery of Memphis one day to inspect a new building in course of construction there under the superintendence of the Pharaoh's favorite, the chief royal architect, Weshptah. The king and his court were all admiring the work, and the Pharaoh was turning with words of praise to his faithful minister, when he suddenly noticed that Weshptah was unable to hear the

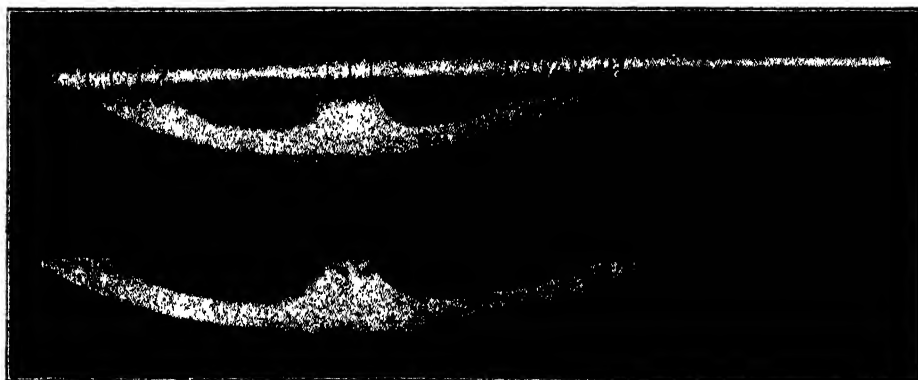
words of royal favor. The king's exclamation alarmed the courtiers.

The stricken minister was quickly carried to the palace and the priests and the chief physicians were hurriedly summoned. The ancient inscription in the Memphite cemetery, which tells us of the incident, then states, "His Majesty had brought for him a case of writings . . . and they told His Majesty that he was unconscious." The king, smitten with sorrow, retired to his chamber in prayer and ordered sumptuous arrangements for the great man's interment in a splendid tomb, which still contains an inscribed record of the circumstances of his death.

THE "case of writings," which the king caused to be brought, was a case of some kind for carrying medical treatises, and Weshptah's tomb inscription therefore contains the earliest known reference to medical literature. Unhappily, none of the actual rolls from that royal "case of writings" has survived to our day. Nevertheless there is plenty of evidence of the advanced knowledge of medicine and surgery in the first great age of Egyptian civilization, which we call the Pyramid Age (about 3000 to 2500 B.C.).

One of the most interesting pieces of such evidence is a human mandible of the Fourth Dynasty (2900 to 2750 B.C.), which still contains unmistakable indications of a successful surgical operation. The patient was suffering from an abscess under the first molar, and by boring a hole through the bone below the molar, the surgeon successfully drained the abscess. This evidence corresponds with the fact that in the Pyramid Age we find a "Chief Palace Physician," who was likewise "Palace Dentist."

The court of the Pharaoh offered opportunity for medical specialization even at this remote period. A tombstone recently found in the vast Gizeh cemetery belonged to a certain Iry, who was not only chief of the palace medical corps, but also served the Pharaoh as "Palace Eye-Physician" and furthermore as "Palace Stomach-Bowel-Physician," in which capacity



BRONZE BATTLE-AXES OF EGYPT, ABOUT 2000 B.C.

Wounds, undoubtedly made by exactly this kind of weapon, are shown in two of the other illustrations. Weapons are from the collections of the Oriental Institute at the University of Chicago

*The publication of the document in facsimile with translation, commentary, and glossary in two volumes is now being printed by the Oxford-University Press and will be published by the University of Chicago Press early in 1929.

he bore the titles, "One understanding the internal fluids," and "Guardian of the Anus," showing that he was particularly versed in internal medicine and that he specialized in diseases of the digestive organs.

As far back as a period beginning about 3000 B.C., therefore, the extraordinary civilization of the Nile Valley already possessed the practice of surgery and had likewise produced specializing physicians.

The earliest physician whose name has come down to us was the illustrious Imhotep, who lived not long after 3000, that is, in the 30th Century, B.C. He served the Pharaoh Zoser, whose Step Pyramid at Sakkara in the desert behind ancient Memphis, is familiar to all tourists in Egypt. Imhotep was at the same time a remarkable architect, the first great builder in stone. He was the royal architect who erected the vast Step Pyramid, the earliest surviving superstructure of stone masonry.

THE gradual excavation, winter by winter, of this great structure and its adjoining buildings, is now steadily revealing to us the surprising genius of this earliest great architect, the father of architecture in stone. It is the more extraordinary that he was likewise the father of medicine, for he was an illustrious physician, whose name survived in the later ages to become the Asclepios of the Greeks, the Aesculapius of the Romans. No writings of this first architect and earliest known physician have descended to us; and as we have already observed, not a single medical roll from that royal "case of writings" has survived to our day.

It is the especial province of the Oriental Institute to study all ancient documents which disclose the rise and progress of early civilization, and not least the origins and advance of science. It was therefore very welcome news, when we first learned of the existence of an ancient copy of a surgical treatise which might easily have been among the rolls in the Pharaoh's lost "case of writings" in the Pyramid Age; for the original author's autograph manuscript was in all likelihood already in existence in the days when Weshptah dropped unconscious at his royal master's feet in the cemetery of Memphis in the 28th Century before Christ.

That original autograph manuscript left by the author himself undoubtedly perished ages ago, but copies of it were still in existence a thousand years after the author's death. All of these long ago disappeared, with the exception of one, which was made in the 17th Century B.C. This one, in so far as we know, the *only* surviving copy, is in the collections of the New York Historical Society. It is the oldest known surgical treatise, and at

mainder of the roll, still rolled up, in his left hand, he began copying at the right end of his long clean strip of papyrus paper. In columns over 11 inches high and varying from 7 to 10½ inches in width, his copy marched on, column after column from the right end toward the left end of his new roll.

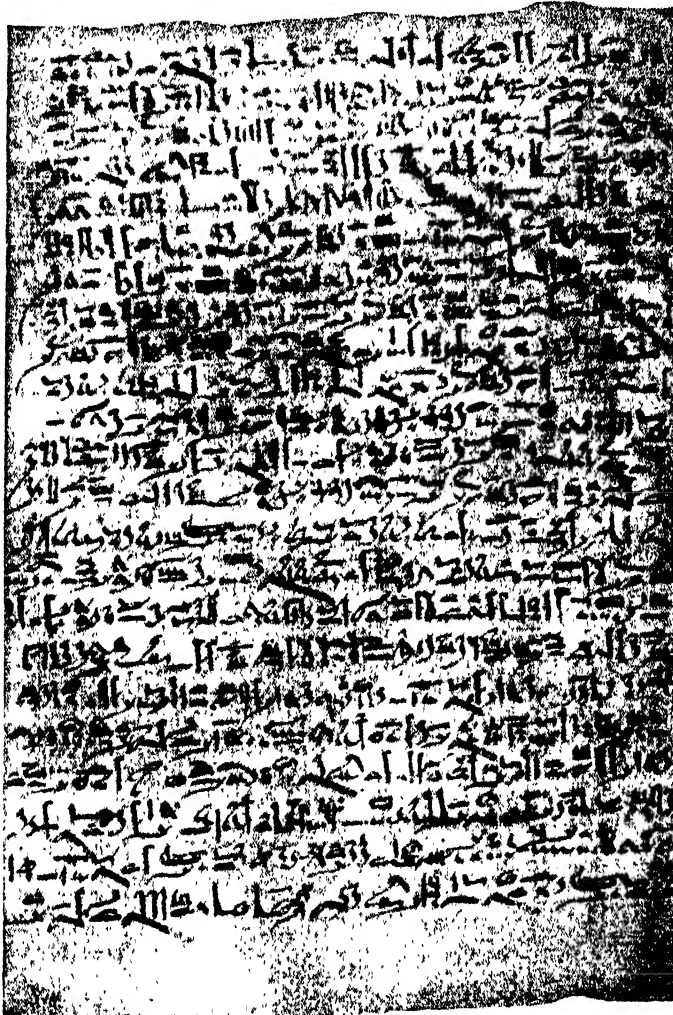
The older roll set up before him, from which he was copying, may already have been centuries old. The venerable surgical treatise which it

bore, however, was then already something like a thousand years old, and of course contained old words and phrases which were no longer wholly intelligible. A long time before our scribe was born, probably generations if not centuries earlier, some one had written out a series of explanations and discussions of these obscure words and phrases, and had scribbled them on the margin of the old surgical treatise. Eventually some scribe, earlier than ours, had copied these marginal explanations directly into the text of the treatise itself, at the close of each case discussed, so that each case was followed by a little dictionary of its difficult terms. This little dictionary had already been incorporated into the body of the treatise when our scribe sat down to his task, and he of course included it in his copy.

HE had copied at least 18 columns (we do not know how many columns there were in the lost introduction), containing some 400 lines, and had reached the bottom of a column, when, pausing in the middle of a line, in the middle of a sentence, in the middle of a word, he lifted his pen and ceased writing. After a

pause of which we cannot divine the cause, but during which his well-filled reed pen nearly dried, he again applied it to the papyrus. He made two more very faint strokes with the almost exhausted pen, which he thereupon dipped deep into his ink pot. After heavily retracing the two pale strokes, but so carelessly that the original faint lines are still visible, he laid down his pen and pushed aside forever the great surgical treatise he had been copying, leaving 15½ inches bare and unwritten at the left end of his new roll.

In my first study of the document, as I pushed on through the difficult discussion from column to column, it was as if I was peering through a newly revealed



THE ANCIENT SURGICAL TREATISE

The original column is about 11 inches high. The ink was made by mixing pure carbon (lamp black) with an aqueous solution of gum

the same time the earliest surviving scientific discussion.

In physical form this extraordinary document is a strip of papyrus a little over 15¼ feet long, and about 13 inches wide. At least a trifle over a foot and possibly much more, has been lost at the beginning of the strip, so that it was originally not less than 16 feet, 4 inches in length. When not in use the papyrus was rolled up and then looked not unlike a roll of narrow wall paper.

The scribe of the 17th Century B.C., taking up the clean unwritten roll, unrolled some 16 or 18 inches at the beginning (right end), and spread it out upon his knees as he squatted cross-legged. Then, while holding the re-



HEAD OF THE PHARAOH SEKENENRE

Five wounds are indicated by arrows. That in the forehead was made by a bronze battle-axe like the one shown on page 489. The pharaoh was slain in battle or was assassinated about 1600 B.C.

window, through which no man had ever looked before, and I was looking out upon the once impenetrable gloom enveloping man's earliest endeavors to understand the world he lived in. It was as if an unseen hand had been slowly raising the curtain that covered this window, and then when I reached the blank space at the end of the roll, which told me so inexorably that the scribe had stopped his copy at that point, it was as if the hand that had been lifting the curtain had suddenly refused to lift it further.

THAT provincial scribe sitting over his roll 3500 years ago, had little dreamed when he dropped his pen so carelessly and left the ancient surgical treatise incompletely copied, how hungrily future ages would ponder his unfinished transcription, the only surviving copy of the ancient surgical treatise. As already stated above, he had reproduced at least 18 columns of the earlier roll—something over 400 lines.

Beginning at the top of the head and proceeding systematically downward, the treatise had presented case after case through successive, carefully arranged discussions, forming a series of 48 cases. The scribe had been none too careful in his copying and he had made many errors. In two places he inserted on the margin unintentional omissions and indicated their proper position in the text by a cross, the earliest known asterisk in the history of books. He had industriously shifted from his black ink to his red and had liberally distributed his rubrics marking the heads of his paragraphs. He was much more interested in these matters than in the content of the extraordinary document he was

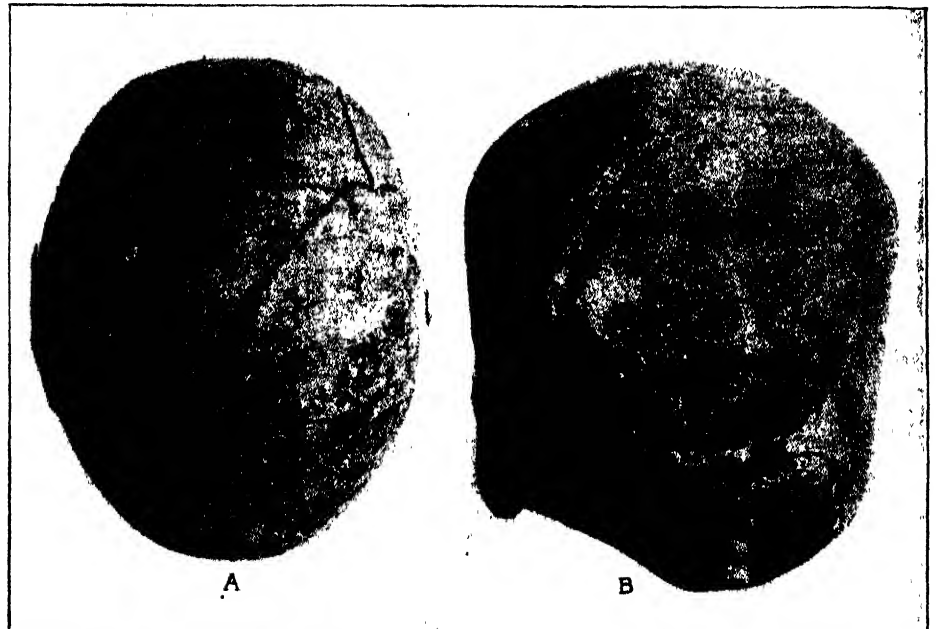
copying. He found his work somewhat trying, for it contained unfamiliar terms and unaccustomed signs like the human mandible, which caused him difficulty and sometimes resulted in awkward, uncertain characters. His copying had carried him from the human head downward through the neck to the thorax, and he had begun the first case on the spinal column, when he stopped. One can imagine him yawning, rising indifferently and going home to his dinner, quite unconcerned, and altogether unaware that he was leaving the future civilized world entirely without any knowledge of his great ancestor's discussion of the surgery of the internal organs, which

in all likelihood followed immediately on that of the spine.

Our regrets are not a little aggravated when we consider the fact that our scribe returned to his task and took out again his unfinished copy; but he turned it face downward and on the unoccupied back he began copying the customary random magical recipes current among the physicians of his time, drawn from the traditional folk medicine inherited from the superstitions of a remote past. A later hand added some recipes for a youthful complexion, including at the end especially one for "Transforming an Old Man into a Youth." These products of popular medicine have nothing to do with our surgical treatise, and they are unmistakably separated from it both by the blank space at the end of the roll, and by the fact that they are casually scribbled on the back of the roll as we ourselves jot down notes on the fly-leaf of a book. We need therefore pay no further attention to them.

THE surgical treatise itself probably served as a reference book consulted daily by the practicing physician, while at the same time it partook of the nature both of the medical lecturer's outline and the student's notebook; for the ancient medical student will have roughly reproduced the form and content of his instructor's lecture notes and may afterward have continued to employ his note-book as a reference handbook.

Some physician of ancient Thebes, in the days when the Hebrews were captives in Egypt, must have had the roll in his medical library at the close of the 17th Century B.C. When he died, there is every probability that



Photographs by Dr. G. Elliot Smith and Dr. F. Wood-Jones

TWO ANCIENT EGYPTIAN SKULLS, DISCLOSING WOUNDS

The skull at A was cut by a battle-axe. Obviously the man was killed, for no traces of healing are visible, but the skull wound at B was treated by the surgeon, the wound healed, and the man survived

his friends placed the roll in his tomb somewhere in the great Theban cemetery in the cliffs opposite modern Luxor. It had been lying there some 400 years when the Trojan Wars were fought and the Hebrews were entering Palestine; it was over 1200 years old in the Age of Pericles, and the entire history of Europe and America has been enacted since our scribe made his copy.

Then, when it was some 3500 years old, it was presumably found by Luxor natives, probably in a Theban tomb, although there is no specific evidence indicating exactly where these natives had found it. Shortly afterward an American named Edwin Smith, who had been residing in Luxor for some years, purchased it during our American Civil War, more exactly in 1862, from a Luxor native named Mustapha Aga. Mr. Smith died in 1906 and his heirs thereupon presented the unique document to the New York Historical Society, to whose Executive Committee the present writer owes the opportunity of describing it.

THE Papyrus nowhere hints at the name or station of the author of the surgical treatise. We are free to wonder whether the great unknown surgeon who produced this earliest-known investigation of human anatomy, physiology, and pathology could have been identical with our oldest-known physician, the venerable Imhotep, the father of both medicine and architecture already mentioned above, who lived in the 30th Century B.C. It is evident from his treatise that our ancient surgeon, whoever he may have been, was a man of observant and discerning mind, with a wide outlook upon the life of his time. The terms which he uses convey the impression of a man actually involved in the process of building up a terminology in a field of observation not yet possessing a fund of current terms.

He seems to be doing for the first time in any field of science what has since happened in one area of scientific observation after another.

HE draws his items of comparison and his descriptive terms from nature, from the mechanical arts, from architecture, and from many sides of daily experience. He has observed the crucibles of the copper foundry and he compares the convolutions of the human brain to the corrugations on metallic slag. In describing the articulation of the human mandible with the skull, he likens the fork at the head of the ramus where the mandible hangs pivoted, to the claw of a two-toed bird clasp the temporal bone—a very apt comparison. He applies the name of a certain water worm to fibrous strings of coagulated blood, and the ancient commentator carefully explains that the actual worm itself is not meant; the region of the frontal sinus is “the secret chamber,” as of a sanctuary; the bridge of the nose is for him “the column of the nose”; a puncture of the cranium is compared with a hole broken through the side of a pottery jar.

Socially considered, the treatise is the outgrowth of the earliest great age of civilization, the age that first saw a civilized society of some millions of souls organized into a homogeneous

nation. It was only in such a situation that oriental medicine could develop and in any measure approximate the character of a science. We find this fact illustrated when we take up the study of the cemeteries where the Egyptian communities buried their dead several thousand years ago.

A SINGLE campaign of excavation which exhumed between 5000 and 6000 bodies, disclosed one person with a fractured bone among every 32 people, that is, over three such injuries among every hundred people. A broken neck is stated by our treatise to have been caused by a fall on the head—evidently from some elevation. Among the mechanics and workmen employed on the vast buildings of Egypt, such as the Great Pyramid of Gizeh, there must have been many such accidents. We can easily understand why there are 33 cases of injured bones among the cases discussed in our treatise. Many, perhaps most of these injuries, were received while the injured man was following the peaceful routine of civil life.

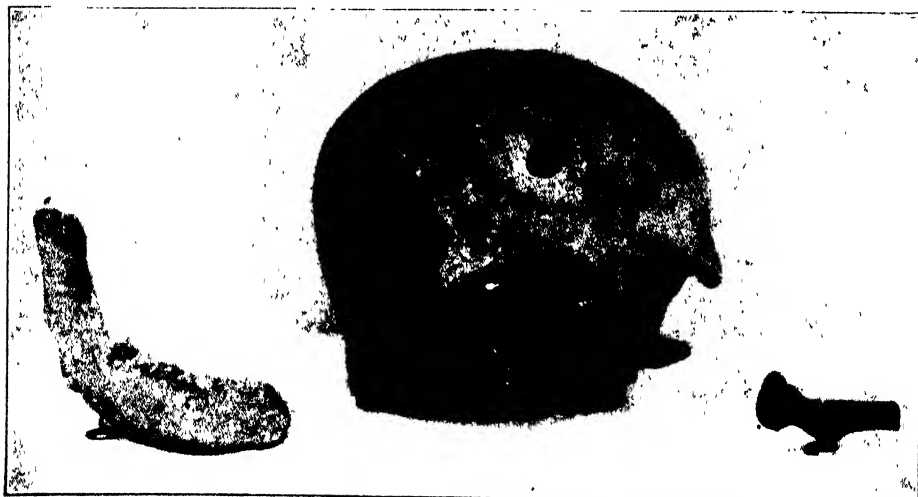
No one can read the treatise, however, without concluding that some of the wounds in the skull, for example the “perforations” found in the skull, the temporal bone, the zygoma and the sternum—not to mention the gashes in the soft tissue of the nose, lip, chin, outer ear, neck and shoulder—were spear and sword wounds received in battle. Some of



Courtesy of Dr. G. Elliot Smith

AN EMBALMING WOUND

Stitched by the 11th Century B.C. embalmer. Much earlier surgical stitching is described in the Edwin Smith Surgical Papyrus



SKULL OF HARSIESE, HIGH PRIEST OF AMON

Ninth Century B.C. He was struck on the forehead. The bone shows signs of absorption; death was not instantaneous. The Edwin Smith Papyrus discusses perforations of the skull like this. Discovered by the Oriental Institute Expedition of the University of Chicago last winter

the experience and knowledge of the human body which the ancient author discloses, was therefore doubtless gained on the battlefield while following the armies of Egypt. In harmony with this observation, it should be noted that the patient is always a man.

The illustrations accompanying this article and showing wounds received

process of eviscerating and embalming.

Our ancient surgeon was therefore already acquainted with the brain, and the word "brain" appears in this treatise for the first time in human speech, in so far as early records are preserved to us. He had observed that the brain is in intimate connection with the control of the limbs, and he

followed by a diagnosis based on the examination and continuing with a treatment, if any is possible. The treatment is only slightly medicinal, the most notable office of the surgeon being his mechanical manipulation. It is interesting to find him practicing surgical stitching or "suture," the earliest known application of this mechanical aid to healing, and when he found stitching impracticable, he employed adhesive tape or plaster. His directions for setting dislocated or fractured bones show a good understanding of the proper physical manipulation, and his instructions for reducing a dislocated human mandible are closely reproduced in an illustrated edition of the essay on the joints written by Hippocrates over two thousand years later than our Egyptian surgical treatise.

It is clear that the ancient Egyptian surgeon was daily called upon to deal with human ills which were the obvious result of observable physical causes, and having therefore no connection with the malignant demons of disease popularly regarded as the source of all ailments of the human body. For our treatise shows us the surgeon examining case after case of organs and tissues injured by intelligible physical agencies forming a realm of familiar forces, quite uninvaded by magical powers.

IN this realm the ancient surgeon was able to gather a considerable body of fact regarding human anatomy, physiology, and pathology—the earliest known recorded group of rational observations in natural science. Indeed these two men, the unknown surgeon who was the original author of the treatise, and his later, equally unknown successor who wrote the little dictionary of technical terms, both of them living in the first half of the third thousand years B.C., were the earliest known natural scientists.

It is quite evident that the work and writings of such Egyptian medical men could not have remained unknown to the great Greek physicians, who carried on their investigations in Alexandria after 300 B.C., side by side with the Egyptian medical schools, one of which we know was refounded a few generations earlier by Darius the Great at Tanis, within a stone's throw of Alexandria. Our unknown Egyptian surgeon, and his colleagues reaching back to Imhotep of 5000 years ago, were therefore the scientific ancestors of modern medical scientists who have probably been accustomed to regard their scientific ancestry as reaching back no farther than the Greeks. The modern physician, however, is entitled to consider himself as a descendant of a venerable line which may be traced back to the 80th Century B.C., and this can not be said of any other modern scientist.



REDUCTION OF A DISLOCATED JAW

This picture is Greek—First Century B.C. The surgeon's position is exactly the same as prescribed in the Edwin Smith Papyrus and thus shows that the older Egyptian medical science influenced early Greek medicine and surgery

in battle, would also confirm this conclusion. Extraordinary evidence of the same kind has recently been published by the Metropolitan Museum of New York in the form of a series of wounds found on the bodies of a group of 60 soldiers who fell in battle in the 21st or 22nd Century B.C., and were buried in the same tomb at Thebes. There is also other knowledge of organs and tissues which would indicate that our ancient surgeon practiced dissection of the human body while carrying on these earliest known investigations in anatomy and physiology. In this way the surgeon gained knowledge which could not have been acquired in the mere

had already noticed the localization of function in the brain. He charges his readers to note the side of the skull on which an injury is found, and to correlate it with the side on which paralysis of the lower limbs occur. He was aware of a cardiac system, with the heart as its center, and he knew that the action of the heart extends to the remotest extremities, but he does not indicate a knowledge of the circulation of the blood, although he was without doubt close to that observation.

He arranges his cases very systematically. Following the title which is always at the head of the case, he introduces his discussion by the record of the examination of the patient



Courtesy Illustrated London News

A Prehistoric Scene in Mongolia

THE 1928 expedition of the Central Asiatic Expedition of the American Museum of Natural History, led by Roy Chapman Andrews, has completed its work, and the reports of the findings are extensive and interesting. The above illustration, drawn by Miss Alice Woodward, shows the probable appearance of three of the prehistoric beasts, bones of which were discovered by the expedition. In the

foreground is what is conceded to be the largest land mammal known—a giant Baluchitherium, standing from 13 to 14 feet high at the shoulder. This animal fed on the leaves and twigs of trees. On the top of the knoll is a new species of Titanotherium, with an extraordinary, long, spatulate-shaped nose. In the left background is a shovel-toothed mastodon. Its peculiar teeth are nearly a foot long.

OUR POINT OF VIEW

Secrecy and Science

MOTH-BALLS, known to chemists as naphthalene, belong in fur coats; not in an automobile gas tank. Neither they nor any of the numerous secret dopes sold under the claim that they have anti-knock or power-increasing characteristics, have any good effect on the gasoline, according to findings of the Bureau of Mines.

The fallacious theory that moth-balls, dropped into the gas tank, will give an anti-knock mixture, is widely prevalent. With a carburetor adjusted for too rich a mixture, naphthalene increases the viscosity of the fuel so that the volume fed is cut down, thus actually giving more miles per gallon of gasoline, but the same result can be obtained by proper adjustment of the needle valve.

There are many secret dopes on the market masquerading under fancy trade names and perhaps perfumed and colored. Some of them are simply powdered moth-balls while others are composed of harmless and ineffective coal-tar products. Most of them are frauds.

The scientific formulas of responsible manufacturers are not secret. Some day, perhaps, an anti-knock substance more efficient than the present ethyl fluid may be developed. If it is, the chances are some-odd millions to one that it will be the product of many years of constant research and labor and the expenditure of large sums of money rather than the chance discovery by an ordinary person. And, although it won't be an ordinary chemical, its formula will certainly not be kept secret.

The Inter-American Highway

IT will not be a great many years before a single broad highway will stretch with never a break from the Dominion of Canada to the Republic of Argentina. Here and there on the southern half of this main road, branch roads will shoot out to the east and west, so that every country in North America and South America will be in contact with this one great artery.

Afoot and ahorse and a wheel, men and women will travel from one land to another, exchanging their merchandise and their ideas. Nations now separated not alone by natural barriers but by barriers of misunderstanding will be brought closer together. Whatever the highway will have cost will be only a fraction of its value to mankind.

It is no idle dream. The Seventieth

Congress passed a resolution authorizing Government assistance in the construction of such a highway, and the House Committee on Foreign Affairs has published its report on the project. And one of the strongest

John Bernard Walker

AN editor's success depends upon the extent to which he commands the confidence of his readers and the amount of influence his writings exert upon the thoughts of others. He is to be eulogized when throughout his career he has gone to the bottom of subjects and has then presented them in a clear and thought-provoking manner, without fear or favor.

John Bernard Walker, who died on October 17, 1928, after an illness of three months, was just such an editor. Evading no issues, he fought his verbal battles with a keen zest for the truth regardless of consequences. Born at Bournemouth, England, in 1858, he came to this country in the late eighties, became a member of the editorial staff of SCIENTIFIC AMERICAN in the early nineties, was one-time editor and, at the time of his death, editor emeritus. He had retired on January 1, 1928, due to ill health and was traveling and continuing to send in contributions when stricken with a fatal illness.

Mr. Walker was an authority on army and navy affairs, on yachting and modern engineering. He was a careful worker and was always sure of his facts. The editorial page for years was made up largely of contributions from his indefatigable pen. He was a naturalized citizen and enjoyed not only the friendship of a host of army and navy men but also the confidence of men high in governmental positions. Always a strong proponent of preparedness, he assisted greatly in promoting a general desire for preparedness prior to the World War. While the bulk of his writings appeared in SCIENTIFIC AMERICAN he also wrote "The Unsinkable Titanic" and "The Story of Steel."

We know that the thousands of readers who have enjoyed his writings and have been guided or influenced by Mr. Walker's written thoughts, will join with our editorial staff in this expression of sorrow for his demise.

reasons for the construction is its value to aviation. Not only will the highway serve as a marker for those who travel by air, but it will be of such width that at any point and at any time it will afford a safe landing place for planes forced down.

Seaplanes

AFTER each serious aircraft accident involving a land plane and water, the cry goes up for regulation of over-water flights with planes which can land only on more or less dry ground. Why have many aviators, who know the hazards of over-water flight, undertaken just such projects with equipment designed for operation over land? The answer is simple. Land planes are comparatively light in relation to engine power, and so can carry more fuel than a similarly powered seaplane. A plane designed for water work, that will be reasonably seaworthy when forced down, has a considerable proportion of its total weight concentrated in its floats, regardless of the form they may take. As fuel is the most vital consideration in a flight of great duration, land planes are frequently selected for work other than that for which they were designed and for which they are safe.

Before seaplanes can become practical for long-distance flights with economy of operation, engines must be designed which will lift them as well as the huge amount of gasoline which must be carried. It is all a matter of engineering. When more powerful engines are built, seaplanes will come into their own.

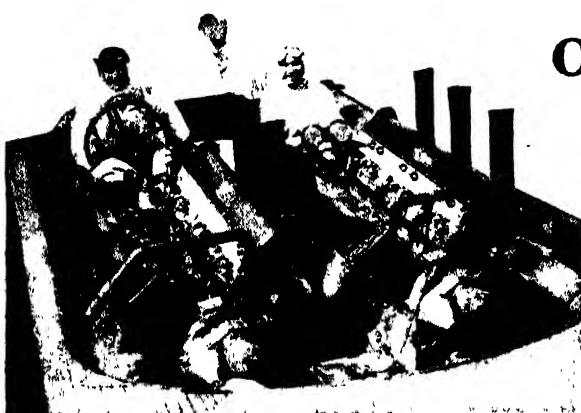
Doubtful Altruism

WHEN Dr. R. W. Browne went to Fort Bayard, New Mexico, not long ago to take charge of the Veterans' Hospital, he found life in an automobile was just one puncture after another. A large number of temporary buildings had been torn down and the lumber salvaged; the roads over which the lumber was hauled for storage was full of nails, tacks, and other sharp pieces of metal.

Being a practical man, he called Chief Engineer Martin. They took an old Ford car minus wheels and top and set it on a truck. This supplied power to run an electric generator that happened to be idle. Then they made a magnet out of a 12-inch I-beam four feet long, mounted on an old Ford axle. With this device they went out on the roads and in no great time picked up 4690 pounds of nails and other metal. Punctures thereafter were reduced by 75 percent.

But you can't please everybody. The garage owners wish the doctor had stayed in the east where he belonged. The large income they enjoyed from tire repairs on the road from Fort Bayard to Silver City has been cut off almost entirely.

From the Scrap-book of Science



P and A

A NEW SPEEDBOAT RECORD

George Wood and his mechanic in the stern of *Miss America VII* in which Wood recently made a new world's record of over 92 miles an hour on the Detroit River. Above at right: the speeding boat

Illustrated
London News

P and A

◀ FOR CAPTAIN COOK

The strip of ground on which stands this monument, erected in Hawaii in 1874 to the memory of Captain Cook, discoverer of the Sandwich Islands (now Hawaii) who was killed on this spot, is British territory. Since a great many visitors land here, Australia plans to build a new stone jetty in front of the monument

▲ ONE-TON CAMERA

Called Fraser's High-Speed Drum Camera and invented for the purpose of photographing swiftly-moving flames and explosions, this one-ton camera was designed by Professors R. P. Fraser and W. A. Bone of the Imperial College of Science, England. Exposure is one ten-thousandth of a second



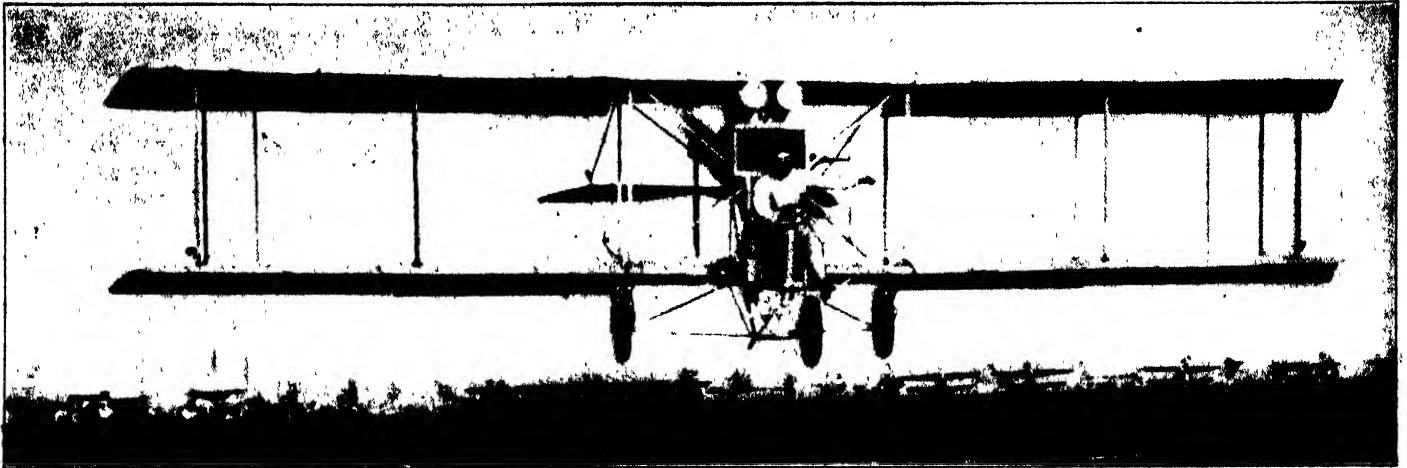
Harbert



HERE'S THE "LOW-DOWN" ON THE "MOVIES"

Those of you who saw "The Thief of Bagdad" will remember the magic carpet scene shown above. All that was necessary in order to shoot this scene was the construction of this miniature, suspended and manipulated by tiny

wires, invisible in the studio light, to obtain that softly undulating effect. Above is shown the tiny "ocean liner," *Fanny*, also used to create an illusion. In a tank no larger than a bath-tub, it was tossed by electrical mechanism



P and A

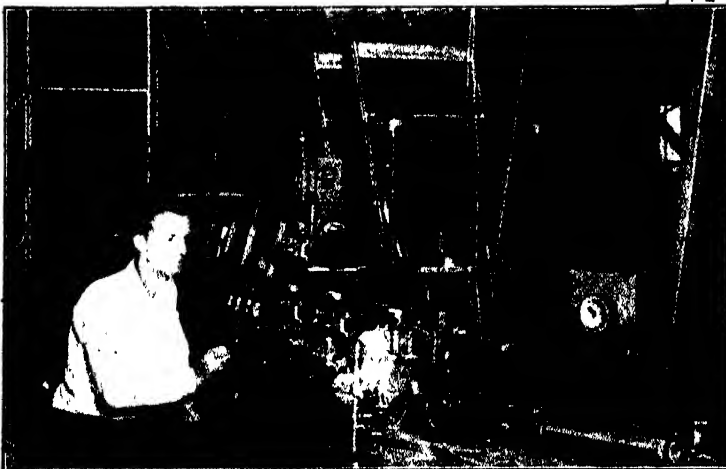
OUT-STUNTING MODERN PLANES WITH AN OLD ONE

A tremendous crowd of 80,000 people at Mines Field, Los Angeles, California, got a real thrill when Al Wilson, an ace among stunt fliers, took an old airplane of the vintage of 1910 aloft and performed stunts that would be difficult

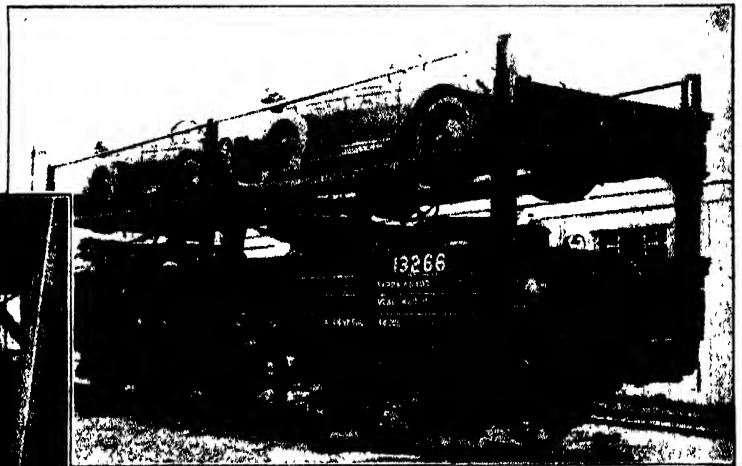
even with modern aircraft. The plane was a Wright pusher type biplane on which there is no fuselage, the pilot sitting in an exposed position in front, and the rudder and elevator extending behind on a skeleton frame

DOUBLE-DECK RAILWAY TRUCK

Designed, patented, and built in South Africa, this double-decked railway truck is used to transport automobiles fully assembled and ready for driving. The photograph shows how efficiently space is utilized, each truck having twice the capacity of old types of car-carrying trucks



Henry Miller



P and A

ERROR CHECKER

A. M. Kueth of the Bureau of Standards in Washington, operating the equipment designed to find errors in wind tunnel readings. The elaborate audio amplifier is used to record variations in heated wires interposed in the air stream of the tunnel. The equipment is complicated. In the upper part of the photograph the wind tunnel may be seen



George Stone from Ewing Galloway

THE EXPLORERS HAVE AN AUDIENCE

Marine iguanas, supposed to be throw-backs to reptiles of prehistoric times and sometimes six feet long, come out to watch members of the Galapagos Expedition for the Visual Education Service of Los Angeles, California, as they work on their collection on Albemarle Island of the Galapagos Group during their explorations



SEXTANT CAMERA

Invented by Commander M. R. Pierce, U. S. N., this camera is to be used by Commander Byrd in the Antarctic. It photographs a reading of the sun in relation to the horizon

The Secret of the Bladderwort

This Carnivorous Aquatic Plant Is An Efficient Trapper of Small Animals. The Mechanism of Its Trap, A Unique Device Which Operates by Suction, Has Recently Been Discovered

By ALEXANDER F. SKUTCH, Ph.D.
Johns Hopkins University

ONE of the fundamental differences between plants and animals is in the manner in which they obtain their nourishment. Plants fill all of their material requirements with relatively simple substances which they draw quietly, imperceptibly from the soil and air, and for their energy they imprison a portion of the force of the sun's rays. The whole process of the nutrition of plants is so silent, so unobtrusive, involves particles so far removed from the limits of even microscopic vision, that mankind had eaten plants, cultivated plants and bred plants for untold centuries before he obtained the slightest inkling of what plants actually do require for their nourishment.

Animals, on the other hand, must seek gross particles of complex substances such as grass or fruit or flesh, and whether the beast be carnivorous or vegetarian, we can, in the final analysis, trace the food to its source in plants.

A MORE thorough study of the physiology of plants reveals to us that it is only the green plants which are self-sustaining in the strictest sense. Already, when we have picked our first mushroom, if we read its story rightly, we learn that all plants are not the splendidly independent organisms which others seem to be, but some have degenerated to the point where they must derive sustenance from the decaying bodies of others, or even of animals.

These scavengers of the vegetable world we call saprophytes. Others, the parasites of the plant world, prey upon the living tissues of other plants, or in some cases upon living animals. Yet both saprophytes and parasites appropriate their nourishment in particles beyond the limits of microscopic vision, and do not, like animals, gulp down tangible portions of food.

There is a small but immensely interesting group of plants which

approaches still more closely the habits of animals in matters of diet, in that they capture and in some cases actually engulf living creatures. These have been called the insectivorous plants, but such an appellation is not strictly correct, for many of the small animals which fall a prey to these plants belong in other classes; and so it is more proper to term our plants carnivorous.

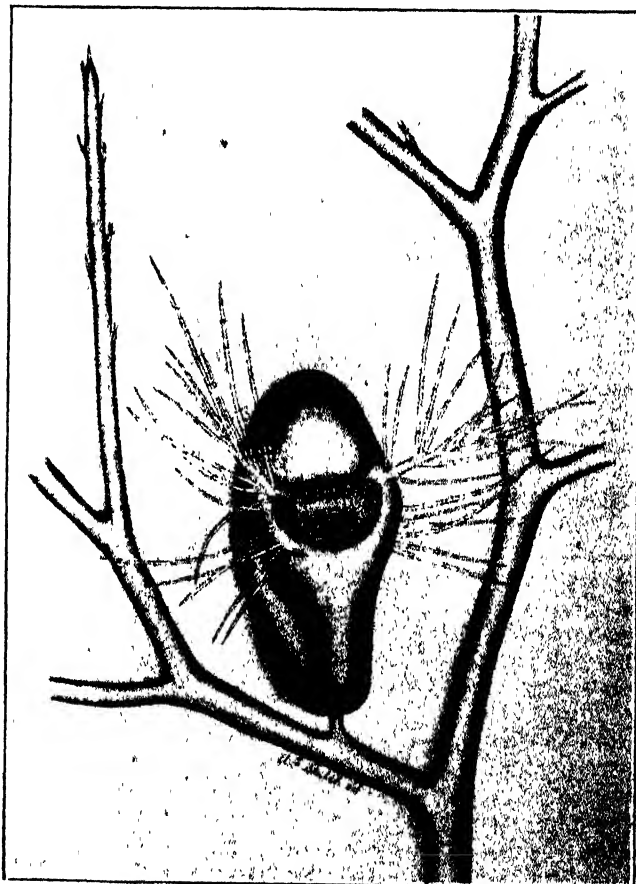
It is of considerable significance that all of the carnivorous plants belong to the group of flowering plants, and practically all of them are provided with the green pigment chlorophyll, so that they are able to build up carbohydrates and to secure their own energy from the rays of the sun. This circumstance sets them off sharply from the great host of wholly dependent saprophytic and parasitic fungi, and from most of the parasitic flowering plants. Their carnivorous diet merely supplements the nourishment they are able to synthesize from the substances they draw from the soil, or water, and the air. It seems that they entrap small animals primarily to meet a deficiency of nitrates and other salts which is felt in their native soil or water, by utilizing animal proteins, which are a rich source of the necessary elements.

What a most amazing array of ingenious pitfalls and snares are presented to our observation and thought by these carnivorous plants! The leaves of

the marsh-dwelling sundew are covered by a number of tentacles which radiate from the upper surface like pins from a pincushion, and are expanded at the ends into spherical glands—the pin heads. The glands are enveloped in a sticky fluid which they secrete, so that they glisten in the sunlight like so many morning dew-drops, whence the name. If an unsuspecting insect, either by chance or attracted by the shining dew-drops, alights upon the leaf, it is held fast by the sticky secretion.

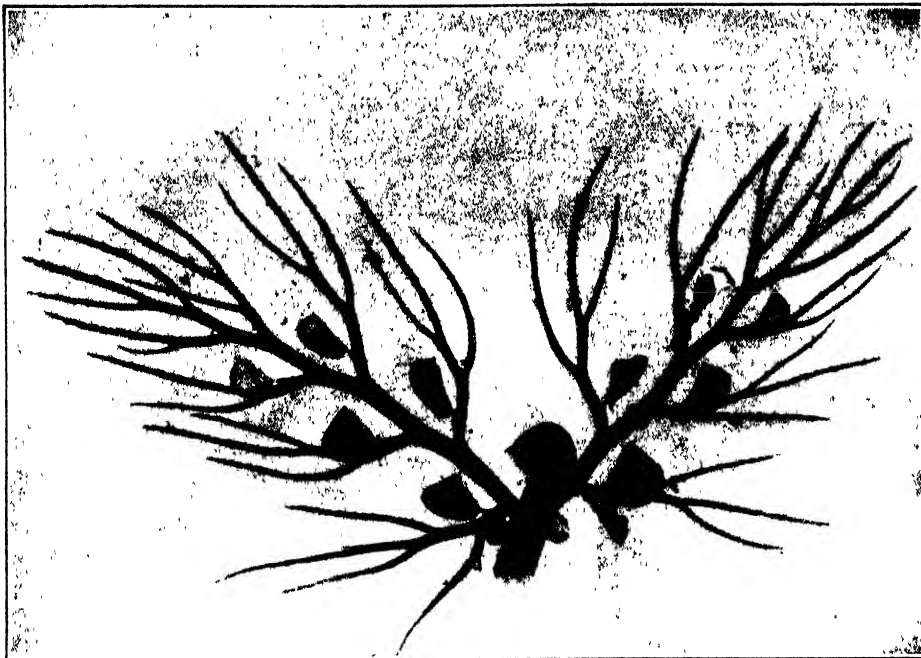
ITS struggles to regain freedom result only in stimulating more of the tentacles to bend their sticky heads over it and hold it in a firmer embrace, so it is the old story of Br'er Rabbit and the Tar Baby over again. This octopus of plants long anticipated the tactics of the fowler with his bird lime. The insect is digested by a secretion which the versatile glands pour over it, and by these its nitrogenous compounds are absorbed into the leaf.

Then there is the Venus's fly-trap, a small, white blossomed herb which is confined to a restricted portion of the Carolinas. The leaves are hinged in the middle, and each half bears several peculiar bristles upon its upper surface. When an insect, crawling over the leaf, happens to bend one of the bristles, the two halves spring



THE TRAP SET FOR A CAPTURE

Here the bladder is enlarged about 15 times. The valve with its four bristles and its many glandular hairs shows plainly.



A SINGLE LEAF OF THE GREATER BLADDERWORT

Enlarged about three times, with the attached bladders, viewed from behind. Over 100 bladders have been counted upon a single leaf of the plant; usually, however, there are only about a dozen

rapidly together, the long comb-like teeth which cover the margins interlock, and the prey is firmly entrapped. To compare our plant again with man-made devices, one thinks first of the cruel steel trap.

The pitfall has been developed to a high degree of perfection by several genera of carnivorous plants. The most familiar is our pitcher or side-saddle plant, a denizen of cold sphagnum bogs of eastern North America. The trumpet- or pitcher-shaped leaves of these plants all operate on the same principle: the animal crawling over the mouth of the trumpet ventures onto the slippery inner wall, where it loses its footing and glides down to the bottom. Its escape from the bottom of the pitcher is made difficult by bristles all pointing downward. Once inside, the animal decays, in our native pitcher-plant, through the agency of bacteria, and its nutritious residues are absorbed into the leaf.

THE bladderworts, with their minute suction traps, are in many respects the most remarkable of all animal-trapping plants. Our most common native species, the greater bladderwort, grows in ponds and sluggish streams throughout most of the eastern and central portions of our country, while an almost identical form is found in Europe, the temperate regions of Asia, and our own northwest. During the mild seasons, the long, slender, green stems, clothed with delicate, many-parted leaves, float just beneath the surface of the quiet water. They grow continuously through the warm weather and may attain a yard or more in length.

Roots of any kind are totally lacking, and the unattached plants drift at the mercy of wind and currents.

During the height of the summer, the slender flower stalks are raised above the surface of the water, where each supports from five to a dozen conspicuous yellow flowers in the sun and air. In the autumn, after the seeds have matured, the stem ceases to elongate and develops a compact mass of leaves, resembling a bud, at its tip. The leaves and stem behind the bud die off, and finally it sinks to the bottom, where it survives the winter months among the mud and fallen leaves and decaying pond vegetation. With the return of spring, the resting bud is called into renewed growth by the rising temperatures. Becoming buoyant again, it rises to the surface and expands into a new shoot, which repeats the cycle of its precursor of the previous year.

The bladders, which are the traps of the plant, are borne upon the richly branched leaves. In warm weather these leaves become very long, and during the height of the summer over a hundred bladders have been counted upon a single

leaf; but this is a rather unusual number, and only a dozen or so are more commonly found.

The accompanying figures should convey an adequate idea of their form; their length is about one eighth of an inch. The transparency of the light green walls, which are only two cells in thickness, gives the bladders an appearance of delicacy. The long, much branched appendages, which spring from either corner of the mouth, were termed "antennae" by Darwin, from their resemblance to the antennae of a small crustacean. These and the slender bristles below them probably serve to guide the prey to the entrance.

THE valve, or door which gives access to the interior, which is situated at the end opposite the stalk, is roughly semicircular in outline, and is attached by its curved upper margin. The free margin rests upon a thickened pad or sill in such a manner that the valve may be pushed inward but not outward. The surface which faces outward is strongly convex, and bears, near its free margin at the middle, four bristles, two long and two short. Stalked glands, which secrete a mucilaginous substance, are numerous on the valve and on the sill.

Turning to the inside of the bladder, we find that its walls are studded with numerous four-armed hairs arranged at regular intervals. We have not



INSECT PITFALLS

Sarracenia Catesbaei, a pitcher plant from our southern states. The pitchers are deadly pitfalls for many insects

mentioned nearly all of the bewildering variety of appendages of the bladder, but for our present purposes these will be sufficient.

The trap-like construction of the bladder is obvious. A small aquatic animal, pushing against the valve from the outside, may force it inward and so enter the bladder, but once within it cannot retrace its path, for to press against the valve from the inside results only in forcing it more firmly against the sill. Apparently it is all as simple as the principle of the cage rat trap, which no one but the rat finds it difficult to understand.

But why should the animal enter the bladder, since no living creature voluntarily immolates itself? The rat enters the trap for the cheese, but is there anything desirable within the tightly sealed bladder which is sensed by the animal on the outside, and stimulates it to force its entry? This is a problem which has interested botanists ever since, in 1858, the Crouan brothers, pharmacists and amateur botanists of Brest in France, communicated to the scientific world their discovery that the bladders often contain imprisoned animalcules.

CHARLES DARWIN was the first and greatest biologist to consider seriously how and why the animals which are entrapped in such large numbers enter the bladders. In spite of long and painstaking observations, which he describes in detail in his great work "Insectivorous Plants," he failed to arrive at a satisfactory explanation. He suggested that the animals might be attracted to the bladder to feed on the mucilage abundantly secreted by the many glands surrounding the orifice, and might even "habitually seek to intrude themselves into every small cavity, in search of food or protection," but he ends with the unsatisfactory conclusion that "animals enter merely by forcing their way through the slit-like orifice, their heads serving as a wedge." And in the years which followed, many other able botanists endeavored to penetrate the mystery of the bladderwort, with results equally inconclusive.

Then, about 20 years ago, the Swiss entomologist Frank Brocher became dissatisfied with the generally accepted theory of Darwin. He believed that no one had followed in sufficient detail the entry of an animal into the bladder, and determined to do this for himself. He pushed about small crustacea, injured so that they

could not too readily swim away, upon the upturned surface of the valve, and followed the results with a microscope. In a few cases they suddenly disappeared, to be found later inside the bladder. Next he tried shooting small crustacea against the valve from a fine pipette, usually with no interesting result. Once, however, the animal disappeared inside the bladder, and with it went a bubble of air to which it had become attached while within the pipette. This minute bubble of air was the revealing evidence which unlocked the whole mystery! It told Brocher that the bladder

The secret of the bladderwort once having been penetrated, it was destined to be revealed thrice again before it should become general information. In the year 1916, the late Dr. C. L. Withycombe, then a boy of 18, noticed while observing the bladders with a hand lens that they expand actively on engulfing their prey. This was in England, but in India in the same year another naturalist made the discovery for himself under quite different circumstances.

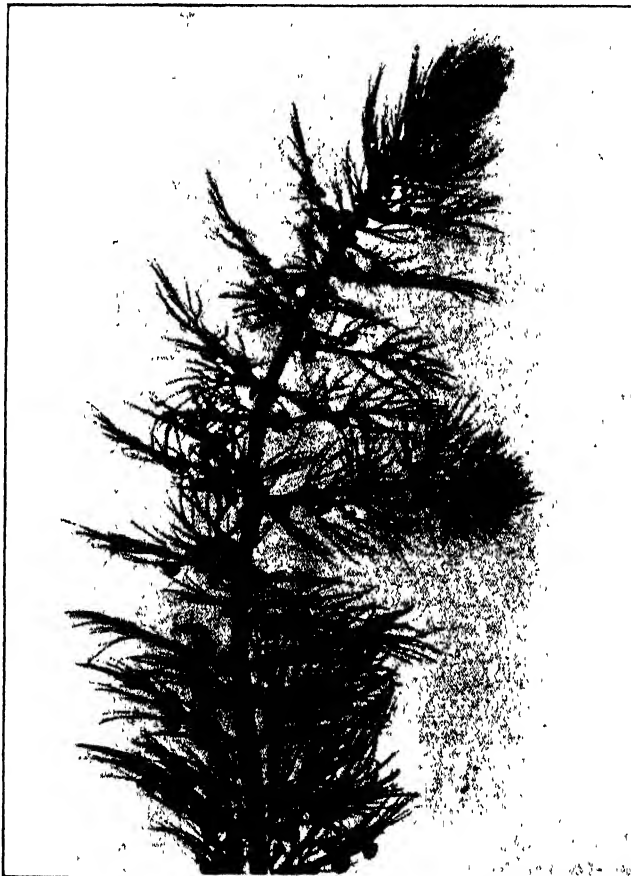
While distributing for class study specimens of an Indian bladderwort with very large bladders, the botanist T. Ekambaram was attracted by crackling sounds, somewhat resembling the ticking of a watch, which he heard as he lifted each spray from the water. He was able to satisfy himself that the sound emanated from the bladders, which expanded suddenly and sucked in air as they were drawn through the surface film of the water, and he recognized that this almost explosive dilation was their method of capturing prey.

FINALLY, in 1925, Professor R. W. Hegner, of Johns Hopkins University, who was studying the fate of minute protozoa entrapped within the bladders, incidentally made the discovery that the bladders capture their prey by suction. Thus the secret guarded so long was revealed on four separate occasions by four different workers in as many different countries, none of whom was at the time of his discovery familiar with the work of the others.

These observations told us how the victims are sucked into their green charnels, but the answer to this question only raised another: How does this rapid expansion come

about? What is its mechanism? To make the complete discovery of the secret of the bladderwort a thoroughly international affair, as all good science is, it happens that we owe our explanation of how the snares work to the recent labors of two German botanists, Edmund M. Merl and A. T. Czaja. It is evident from their studies that the release of the set trap is not, like the folding together of the leaf of the Venus's fly-trap, connected with a specialized, sensitive motor organ, but is as purely a mechanical process as the springing of a mouse trap. Let us choose a bladder which has just expanded and follow its subsequent behavior.

After the entry of the first victim, the valve, in virtue of its outward



BLADDERWORT—LATE SUMMER

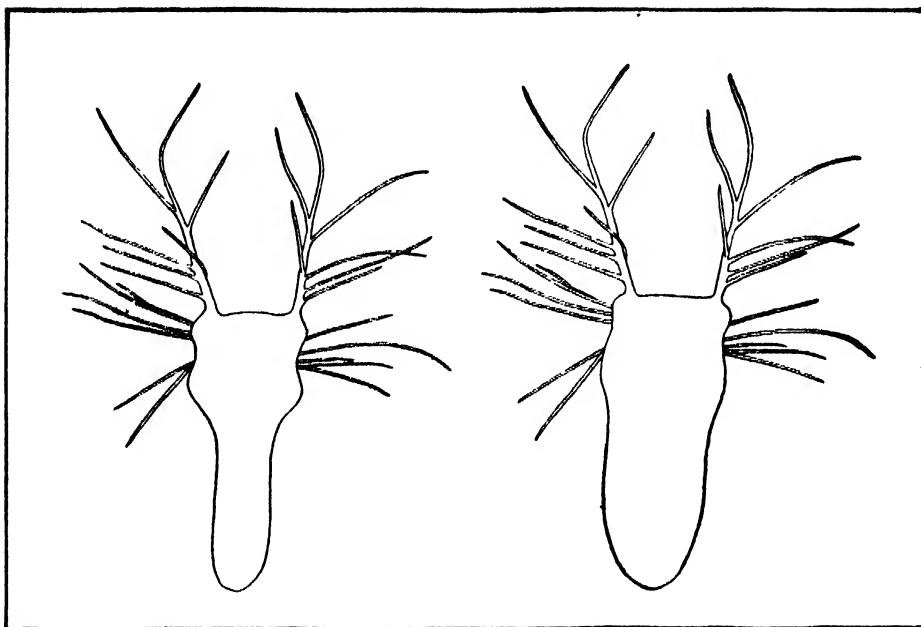
The bladderworts have no roots but they have flowers and they mature seeds. The plants' whole life cycle is unusual

expands as it captures its tiny prey.

Following this clue, he was able to observe that the bladder becomes suddenly distended when one touches with a needle the valve or one of the four bristles which it bears. The same thing would of course occur if the valve or its bristles were disturbed by the impact of a small animal. In expanding, the bladder sucks in a current of water, which carries with it the small creature which made the unfortunate collision. So the bladder is a suction trap, and draws in its prey exactly as the biologist picks up a small swimming organism by releasing the pressure on the bulb of his pipette at the proper moment, or as one fills a medicine dropper, or even his fountain pen.

convexity, springs forward against the sill, where it forms a tight seal because of the thick, slimy covering. The four armed hairs studding the inner wall continue to absorb water from the cavity of the bladder, and this is by some unknown method conveyed outside the plant. Since the tight seal makes it impossible for more water to enter, the side walls are slowly forced together by the pressure of the atmosphere and the overlying water, just as the cheeks are forced against the teeth when one closes his lips tightly and sucks the air from his mouth. The sides of the bladder are elastic and tend to expand, which would draw in the valve and admit more water if the outward curvature of the former, intensified by the pinching of the indrawn walls, did not resist the excess pressure on the exterior.

IF now, 20 or 30 minutes after the snare made its previous capture, a small swimming creature impinges against the valve or its bristles, the whole unstable system is upset. The shock breaks the seal, and now the walls are able to relieve their strain by drawing in a current of water through the aperture, and the ill-omened creature which sprung the trap is carried along by this current. Let us return to our former example of the medicine dropper. We squeeze the bulb and then, putting a finger over the end of the glass tube, release the bulb. The latter remains compressed and corresponds to the set bladder; what happens when we remove the finger from the tube is precisely what occurs when a water animal breaks the seal of the bladder. The whole process occurs in the winking of an eye; one instant the animalcule is swimming against the bladder, the next it is beating against the prison walls in vain search of an



BEFORE AND AFTER SPRINGING THE TRAP

The bladder on the left is set. That on the right has been sprung by the touch of a needle. Sprung bladders contain 75 per cent more water than set bladders. Note difference in size

avenue of escape from its death cell.

Once inside, the animal dies, but often not until after it has been several days a prisoner. It is slowly digested by a very weak digestive ferment, and its substance is absorbed by the four-armed hairs.

The same bladder may be sprung repeatedly, and resets itself each time in from 20 to 30 minutes, even while digesting its latest booty. Set bladders may be distinguished from sprung bladders by the empty appearance of the former and the full appearance of the latter.

If a hole is punched in the wall by a needle, or if a fine hair is inserted between the valve and the sill, so that water can enter freely, the bladder naturally can not become set again, but remains permanently distended. Cold and excessive heat and moderate amounts of poison may prevent the

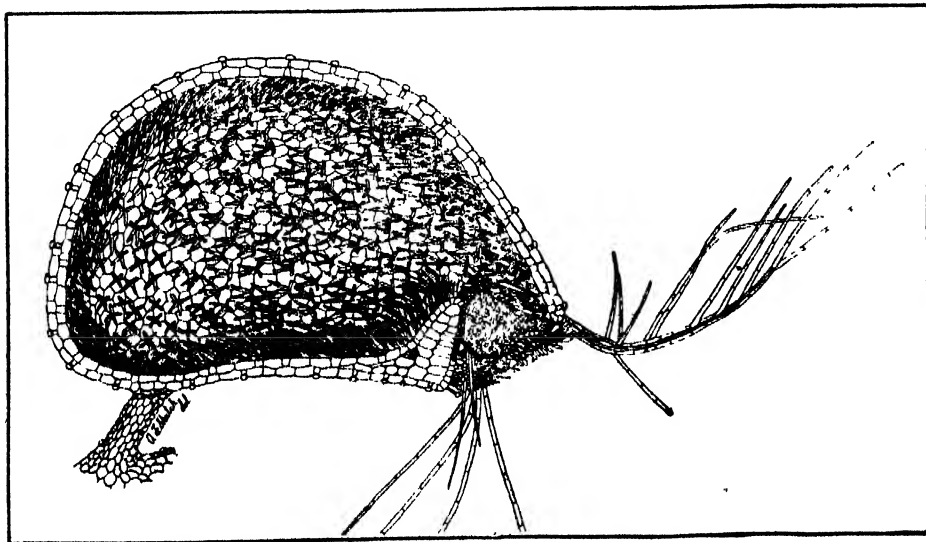
resetting of a sprung bladder, but do not prevent the springing of a set bladder, and this is considered sufficient proof that the springing of the trap is a purely mechanical process, although the setting of course involves the activity of living cells in absorbing water from the cavity.

THE prey of the bladderwort may include almost any of the animalcules which swim about in its native pond or ditch, and are at the same time small enough to pass through the orifice of the bladder.

Various small crustaceans, wheel-animalcules, eel-worms and infusorians constitute the most frequent prey. Mosquito larvae are often caught, and there are records of the capture of wrigglers which were so much longer than the bladder that they could get inside only by coiling up.

Occasionally a vertebrate falls prey to the carnivorous plant. There is extant a picture of several tadpoles being swallowed head first by as many bladders, and we have an isolated record of a school of newly-hatched roach fish which had an unfortunate encounter with the bladderwort. Some of the small fry were held prisoner by the head or tail, others by the still-attached yolk sac—surely a bizarre sight!

The number of animals held prisoner by a single plant at one time may be enormous. A large plant of the greater bladderwort with a combined length of main stem and branches of seven feet, bore approximately 14,000 bladders. The number of small crustacea in each of ten bladders ranged from six to 22, and it was estimated that the entire plant contained about 150,000 of these animals, in addition to numerous creatures of other kinds.



A BLADDER WITH ONE SIDE CUT AWAY

This makes clear the peculiar structure of the valve at the right; also the four-armed hairs which line the inner wall. Once caught, the insect is digested by secretions from the bladder

Calculating Orbits

*How the Astronomer Works Out the Orbit of a New Planet.
There Is Still Work Enough in Sight to Keep
a Single Expert Busy for Ten
Thousand Years*

By HENRY NORRIS RUSSELL, Ph.D.

*Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington*

WE told last month of the way in which asteroids are discovered, almost by machinery with the aid of photography; and something of the hard work which follows for the astronomer before he has his asteroid fairly caught—that is, before a reliable calculation of the orbit can be made. Most of the processes which the investigator follows in such work were, we hope, made fairly intelligible, but at one point a direct appeal to faith was made when it was said that from the observations of the asteroid its full orbit might be calculated. How such a feat can be performed doubtless puzzles the layman. Indeed the calculations which must be made are so long, and in practice so complicated, that even the advanced student who has spent a week in reading the theory and a fortnight in calculation (mainly in correcting his own mistakes) may well “fail to see the woods for the trees.”

THE general notion of the process is, however, not hard to understand for it may be illustrated by a simplified case. Suppose that the orbits of the planets were circles instead of ellipses. It is very easy to see that in this case two observations of a planet would suffice for the calculation of its orbit, and just how the work could be done. A single observation tells us where the planet appeared to be in the heavens—that is, that at the moment of observation it lay in a certain *direction* from the Earth—but gives us no information as to its *distance*.

We may represent this graphically. The size of the Earth's orbit, which for the moment we treat as circular, is already known, as is also the place which the Earth occupies in its orbit at any given moment. We may therefore draw this orbit as in the illustration on the opposite page and mark on it the point *E* at which the Earth was situated when our observation was made. Let us next draw a line *EF* in the proper direction from *E*. Our observation tells us that at the moment the planet lay *somewhere* on the line *EF*, and that is all. So long as this observation stands alone we cannot tell

whether the planet is near or distant.

But if we have a second observation we can answer our question. This observation tells us that the planet was somewhere on another line *E' F'*. Now let us *guess* at the radius of the planet's orbit and draw a circle of the corresponding size, with center at *S*. If this circle cuts the lines *EF* and *E' F'* in *X* and *X'*, these are the points where the planet must have been—provided that our guess at its distance was right. We can measure or calculate what fraction the arc *XX'* is of the whole circumference; and knowing

find that for this distance the period comes out too short for Kepler's law. We have now “bracketed” the true solution and a few more tests will lead us to a distance *SP* which gives exact agreement. The orbit of our planet is thus determined.

For a real planet moving in an elliptical orbit this simple method of calculation would not give accurate results, but a rough orbit calculated in this way is often of practical use in enabling two computers to predict roughly the position of the planet for a month or so subsequent to the discovery, and also well enough to enable observers to photograph it again when desired.

THE calculation of the elliptical orbit, although vastly more complicated, follows the same general lines, using the principles that the planet must be, at the three given times, on the three lines determined by the observation; and that its motion must satisfy *all* of Kepler's laws. In this case the planet's distance from the Earth is first found (by solving a complicated equation of the eighth degree) and then the orbit around the Sun is determined.

The computations are inevitably long and tedious; but three generations of experts have devised ways of saving labor without losing accuracy. The most rapid existing method is one developed by Prof. Leuschner of the University of California. A computer experienced in its use regards the computation of an orbit as a fair day's work. When the first observations are inaccurate—as too often happens, especially for comets—a great deal of time, labor, and patience may be wasted before the errors are all detected.

When all this has been done and done over again with further refinements two or three times, as observations made in later years come in and the first orbit is found to need correction, one might hope then that the trials of the mathematical astronomer were at an end. But the hardest part has not yet begun.

Jupiter and Saturn, not to mention two other planets, are continually at-



PROFESSOR E. W. BROWN

Dr. Brown, of Yale, has spent so many years studying the many complicated motions of the moon, that some who are facetiously inclined say that he controls them

the time between the two observations, we can find by simple proportion the period in which a planet moving at this rate would complete a revolution.

If our guess is right this period will agree with that which is stated by Kepler's famous Third Law, that the squares of the periods of the planets are proportionate to the cubes of their mean distances from the Sun. Probably, however, our guess is wrong. The period may come out, for example, too long to agree with Kepler's law. We then make another guess—say, of a smaller radius, *SY*, for the orbit, and

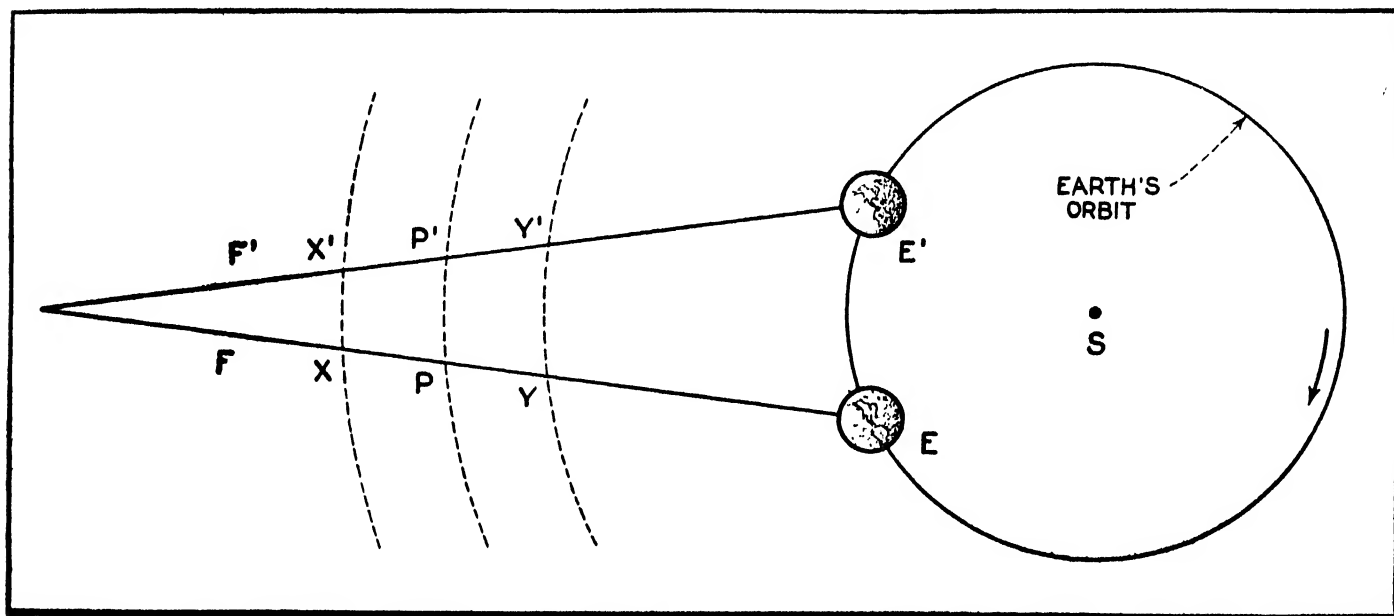
tracting the asteroids. These attractions perturb their motion in such a way that they never follow Kepler's laws precisely. The same thing is true of the major planets; but a body like the Earth which is remote from Jupiter and has near it only smaller planets such as Venus, does not deviate very far from the simple elliptic motion. The asteroids, however, come much nearer to Jupiter, and the resulting changes in their orbits are often very large. To calculate

perturbations, such that when once it had been worked out it would be possible to calculate directly from it where the planet would be at any given past or future date. Such "general perturbations" can be calculated and have been worked out in great detail for the eight great planets and the moon, so that we have "planetary tables" with the aid of which their positions can be calculated for any desired date.

But the computation of such tables

that it can be found close to the middle of a photographic plate centered on the predicted position, and there will be no danger of its getting lost, even if no one looks for it for 20 years at a stretch.

To prepare even such abbreviated tables for a thousand planets is a colossal task, and no more than a beginning has been made. The first requisite for an organized attack on the problem is to know what has already been done for each planet. Such a



HOW THE ORBIT OF A PLANET IS CALCULATED

S represents the sun; EE' the positions of the earth at the times of two different observations; XX' and YY' are estimated positions of the planet, used in determining the positions PP'. For details, see

text. In actual practice, the lines EP and E'P' would usually start upward or downward, out of the plane of the paper. In principle the problem is simple—in actual practice it is very complicated

them is much harder work than anything which we have previously described. There are various ways of attacking the problem.

We may start with the orbit in which the asteroid is moving at a given date, and then work out step by step the changes produced in it month by month by planetary attractions. The methods by which this is done are fully standardized, and it is not hard to learn to work them. Indeed, they are used in all accurate calculations of orbits such as those of the comets or asteroids which have been observed in three or four different years. But they have serious disadvantages, the worst of which is that in order to predict the orbit and position of the asteroid at any given time—say January 1, 1930—we must calculate the planetary perturbations month by month through all the years intervening between the first observations and this future date; and this is extremely laborious. Moreover, the methods do not enable us to make any long-range predictions by means of which we can foresee what will happen to the planet a hundred or a thousand years hence.

Obviously it would be very desirable to have some general formulae for the

is a prodigious task. The latest of them, Brown's Tables of the Moon, occupied their author for 30 years, in spite of all the aid which skilled assistance could render. The theoretical problems presented by the asteroids, according to Professor Brown, are often much more difficult than those of the Lunar Theory, and the tables of their motion could such be prepared—would be far more ponderous than the three large volumes of the Lunar Tables. To prepare such tables for each one of a thousand asteroids would tax the resources of a mathematical Utopia. The present age must evidently be content with a more modest scheme.

WE can not hope to predict the motions of the asteroids as accurately as they can be observed; we may be fully content if we can prepare tables which take into account only the larger perturbations and leave out the multitude of small ones. Such tables will not give the planet's *precise* position at any given time; they may be out by several minutes arc, owing to the neglected terms. But they will be of practicable compass, and they will always give the planet's place so

research survey is now being carried out by Professor Leuschner with the aid of a corps of assistants. As is usually the case today, in science as well as in business, its results take the form of a steadily growing card catalog, in which the more important data are entered and references to all published work on each planet are indexed for future consultation.

To clear up the puzzles and complicated cases which are continually being met with takes much time on the part of highly trained workers, so that it is not surprising that the cost of the work with the most careful management has been thousands of dollars. How much time and money must some day go into the calculations for which this survey is only the starting point, would be rash to estimate; but it is safe to say that the theoretical astronomer, as well as the designer of great telescopes, could satisfy the wishes of benefactors with no small fortunes to bestow.

Volcanoes are a never-ending source of interest to the average person. Scheduled for early publication is an article on this subject, complete with many awe-inspiring photographs.



WOODEN PENSTOCK

A 14-foot pipe of wood stave construction resting on a flood-proof concrete cradle, built for carrying water to a hydro-electric plant. Compare with size of men

handle greater pressures. Then came the need for still larger conduits and the development of the continuous stave wood pipe of large diameter resulted.

Today pipe lines made of wood are constructed large enough to carry a whole river and to change a natural waterway into a man-made stream which is conveyed over mountains and across deserts in defiance of all natural laws. Pipe-making on the gigantic modern plan is a matter of scientific development. Engineering research has found the correct proportions for wooden pipe lines, according to the re-

quirements of pressure and diameter. The material for a great pipe line is shipped "knocked-down" to the point where it is to be built, and the pipe set up there. All of the material is usually manufactured at a single point, which may be thousands of miles from the place where the line is to be constructed. Smaller conduits, ranging in diameter from two inches to two feet, are produced complete at the manufacturing plant and are assembled by simply joining the ends together. This method would be impractical, however, for the pipe lines 12, 14, and 16 feet in diameter, since the cost of transportation would be prohibitive.

IN the continuous stave method of building the larger pipe lines there is great flexibility in the manner of construction. Since the line is built stave by stave, it may be laid to conform with the ground and the general topography of the country. Viewed from a height, these continuous stave pipes extending through the mountainous regions and across the deserts have the appearance of sinuous snakes.

The staves for the pipes are selected straight-grain Douglas fir, cut and planed in an arc corresponding to the diameter of the pipe required, and the edges are shaped radial to the curve. In assembling, the staves are staggered, no two joints coming together. Circular hoops of steel, with adjustable bolts, hold the staves in place and provide uniform pressure around the circumference of the pipe to prevent leakage. The staves are tongued and grooved to guide the builders, and the end joints are tenoned by means of metal plates. The stave manufacturers purchase green lumber and dry it slowly in their own kilns for from four to five days. It is then carefully

Wooden Highways That Carry Rivers

Wooden Pipe Lines, First Used by the Ancients, Now Built In Gigantic Sizes

By LAWRENCE W. PEDROSE

CONVEYING of water for domestic and industrial purposes dates back to early civilizations. The ancient Romans constructed aqueducts which diverted streams of water to their cities and filled their domestic needs. In more recent times bodies of water have been carried over mountains and plains, far from their sources, and utilized to irrigate deserts or to turn the wheels of industry. These modern engineering achievements constitute one of the romantic pages of industrial history, but it is interesting to note that while many refinements have been introduced, methods have been simplified, and quantity production developed, which combine to enlarge the scope of application the principle has not materially changed.

THE Romans bored small tree trunks, joined them together, and carried water to all sections of their beautiful cities. Later civilizations used the same method, and as needs grew and domestic engineering knowledge increased, the use of wooden water mains became universal. In later years the bored tree trunks were bound with iron bands to give them strength to

quirements of pressure and diameter. The material for a great pipe line is shipped "knocked-down" to the



SMALLER SIZES ARE FACTORY MADE

The smaller diameter wooden pipes more closely resemble the old Roman conduits. They are made in the factory, are tightly bound with steel wire, and assembled by joining the ends

graded and put through the sticker machines which, in a single operation, cut the staves to conform to the desired pipe diameter complete with tongue and groove; and then plane them. Then the ends are trimmed and they are again rigidly inspected. The next step is creosoting. The staves are placed in a vacuum at varying temperatures, and approximately eight pounds of preservative oils is injected into each cubic foot of wood. These creosoted staves have virtually unlimited life.

WHERE the smaller, wire-wrapped pipe is constructed, the staves are laid by hand, held in place with bands, and placed in a wire winding machine where a heavy galvanized wire is wound round the pipe under pressure. The wire bites slightly into the wood. The pipe is then rolled to an automatic heading machine which puts on the head. The completed pipe goes to a dipping bath where it is given an exterior coating of coal tar and asphalt mixture, after which it is rolled in sawdust. The final step in manufacture is the putting on of the coupling under steam pressure.

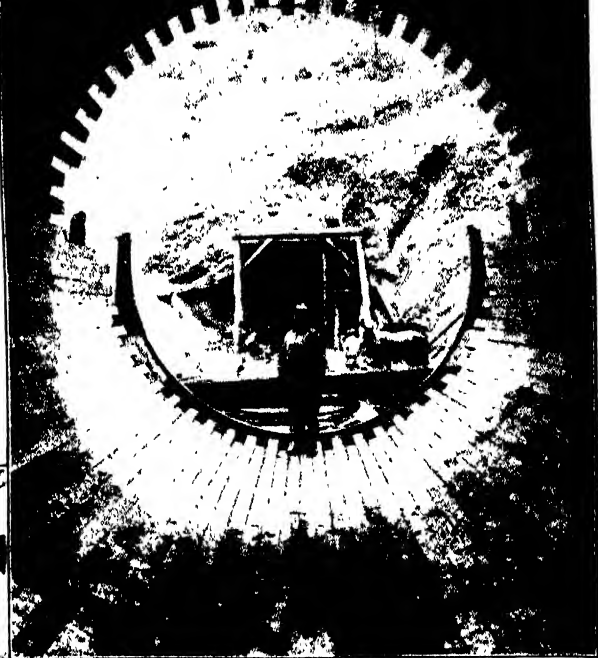
Among recent installations of continuous wood stave pipe of spectacular proportions were a line 16 feet in diameter in California; a triple line of 13-foot pipes which divert, for hydro-electric purposes, the entire flow of the Androscoggin River in New Hampshire; a 14-foot pipe line in Montana; a 9-foot pipe line in northern Canada; a 6-foot pipe line in Spain; a 4-foot installation in Japan; and a 3-foot line in Cuba. How the wood pipe industry aids other



THREE HUGE PIPES

These three wooden pipes, each 13 feet in diameter, were built to divert the whole of the Androscoggin River, New Hampshire, for industrial purposes

industries is revealed by the figures compiled from the recent construction of a four and one half mile continuous stave pipe line for a power company in Colorado. The line required 3,600,000 board feet of lumber, 4,455,600 pounds of steel bands, and



FROM THE INSIDE

A 16-foot continuous stave pipe line built for a hydro-electric project in California

521,933 pounds of malleable iron shoes.

The wood pipe finds a wide variety of uses. While the larger installations are for hydro-electric power projects, municipal water mains, and irrigation systems, the pipes are used widely in hydraulic mining, drainage of mines, steam lines, surge tanks, sewers, road culverts, et cetera. The reasons for the use of wooden pipe lines where great volumes of water must be carried long distances is obvious. Steel pipes, made up of rings riveted together, would be too expensive, and concrete pipe lines, to be strong enough, would have to be very thick and their construction would entail the use of too-complicated forms.



LIKE A MONSTROUS SNAKE

Panoramic view which illustrates how closely the continuous stave construction hugs the ground. Winding snakily across country, such pipe lines may carry volumes of water for great distances



THE EARTH COOLING DOWN AFTER IT WAS THROWN OFF FROM THE SUN

The duration of time since the birth of the Earth, as measured by means of radioactivity (SCIENTIFIC AMERICAN, April, 1928, "How Old is the

Earth?") is at least 1500 million years, possibly 4000 million. The early time depicted above is the lifeless first part of the Archeozoic Era.



THE BEGINNINGS OF LIFE

Pools of blue-green algae, minute plants, still with us today. Remains of their ancestors are the most ancient fossils thus far found



A SEASHORE OF 500,000,000 YEARS AGO

In the Ordovician Period we see great straight-shelled molluscs 15 feet long, ancestors of the modern octopus and nautilus; also trilobites

New Scientific Paintings Outline the Earth's History

THE first seven of a series of paintings designed to present a systematic outline of the evolution of life on our planet has been placed on exhibition in the Ernest R. Graham Hall of Historical Geology in the vast Field Museum of Natural History in Chicago. The paintings were made by the well-known scientific artist Charles R. Knight, and their production was made possible by Ernest R. Graham, patron of science. Although these seven paintings touch only a few of the high spots in evolution, their total time scope is considerably more than a thousand million years.

Most of us know best the geologic time divisions—eras, periods and epochs—which lie nearest our own times; for example, the Tertiary Period ("Age of Mammals") or the Mesozoic Era ("Age of Reptiles") immediately preceding it. Still farther back we recall the "Age of Fishes," and next

the times when only small, still less interesting animals were on the earth.

As we continue, however, to push the already dim horizons of geologic time back to the ultimate, we once more enter into intensely interesting eras—the very earliest ones during which life on earth doubtless originated. Perhaps the larger part of this interest is due to the fact that the origin of life, like its nature, is a profound but intriguing mystery—and we all love mysteries.

FEW realize how long the early, most primitive eras of geologic time were, or that they occupied fully two thirds of the total life of the earth to date. For example, between the time depicted in the picture at the top of the page and that of the third picture, there was a lapse of roughly 1,000,000,000 years—yet even then life had not gone far on its career of

evolution toward the higher, more complicated forms of the present times.

Geologists divide this inconceivably long duration into two eras, a later one in which there was life (the Proterozoic) and an earlier one (the Archeozoic Era), at some time during whose 500,000,000 years we believe life must have begun. How much of this time elapsed between the birth of the Earth from the Sun and the very first manifestations of life? No one knows. There is no known direct evidence. The soft primitive protoplasm of the living things of that time doubtless left little or no fossil record, and if it did, the record was subsequently all or nearly all obliterated by heat and other potent natural agencies.

Geologists from time to time discover earlier and earlier fossil evidences of life, but as yet these carry us only a small fraction of the way back toward the beginning. Professor J.



THE GIANT STEGOSAUR—ALMOST BRAINLESS

In the Mesozoic Era, 120,000,000 years ago, the great reptiles were dominant. The great stegosaurus's tiny brain weighed only two ounces



PROTOCERATOPS, EGG-LAYING MESOZOIC LIFE

The ceratopsian reptiles lived at a later time than the stegosaurus. As time went on they evolved large horns and became extremely formidable

W. Gruner of the University of Minnesota has discovered, in rocks of late Archeozoic Age, certain microscopic fossils of something resembling the modern blue-green algae which a student's microscope will reveal today in many samples of pond water. Even these and similar evidences have, however, been called in question by Professor J. E. Hawley of the University of Wisconsin who asks us at least to investigate the possibility that they are merely chemical manifestations like those called "imitations of life" which can easily be "created" by mixing ferrous sulfide and water glass, and which exhibit many of the characteristics of living matter but do not live.

Indirect evidence—the widespread

ONLY RECENTLY EXTINCT ►

Giant kangaroos, about the size of a rhinoceros, and great wombats of about equal bulk. Ancient man perhaps saw these



◀ THE NEW ZEALAND MOA

This 12-foot bird, which lasted until only a relatively few years ago, brings us up to our own times in the survey of geologic history

presence of graphite in metamorphosed rocks of Canada; the presence of red (oxidized) sediments proving the existence of oxygen available for life, and other indications discussed in geologies (Schuchert's "Historical Geology," for example)—more than hint that life abounded in and during many of the 500,000,000 years of the Archeozoic Era which are such a mystery and a challenge to us. But such indirect evidences are not the kind that satisfy.

How did life start and what is it? For both of these questions there are scores of hypotheses but little conclusive proof. What science seeks is not more hypotheses but some kind of direct, conclusive, fossil evidence. This we may never succeed in finding.

Noise

Despite the Claim, Frequently Made, That One Can Accustom One's Self to Work in Noise, Scientific Research Shows That It Lowers Efficiency

By DONALD A. LAIRD, Ph.D., Sc.D.
Director, Psychological Laboratory, Colgate University
Editor, Industrial Psychology

THE human organism has marvelous adaptability. No had effects can be traced to the adaptation to cold climates or torrid zones, for after a few generations the races inhabiting these regions appear to become perfectly adapted to the extreme conditions under which they have to live.

The United States citizen, however, who moves to the tropics finds dif-

themselves biologically to the change. Is it possible that the gradual increase of industrial, office, and street noises will have like results?

In an effort to answer this question the psychological laboratory of Colgate University is in the midst of a series of experiments which will continue through several years. Data have been gathered from sources ranging from champion typists with a speed in excess of 200 words per minute, to white rats. All indications to date confirm the suspicion that noises may be a more serious problem than the average person is willing to admit.

THE biological harm in noises does not appear to lie in their damage to the ear or auditory nerve, but rather in the fact that noises are an inborn stimulus to cause the fear reaction. Common noises from everyday experience illustrate this fact: The shiver up one's spine when a file or caster squeaks; the involuntary jump at the unexpected report of a pistol; the fear of thunder storms; the fatigue after a noisy railway journey.

Not all noises cause the fear reaction and a small number of people may be exceptions to the rule. As a rule, however, intense noises, or intermittent noises appear to be prime instigators of the fear reaction.

In the cat the fear reaction is indicated by the hairs on the back standing straight up. This is caused

by the contraction of tiny involuntary muscles at the base of these hairs. A similar involuntary muscle contraction is found in human subjects in the fear reaction, causing an increase in muscular tonus or tension. Pulse rate, blood pressure, and breathing are other biological phenomena which may be affected by the fear reaction.

At the University of Michigan a few years ago, for instance, a sleeper was being studied. It was found that when a taxi passed his window in the middle of the night, the noise of the machine caused a rise in blood pressure, even though the sleeper did not awaken.

In experiments upon typists in the Colgate University laboratory it was found that when the noise in the test chamber was reduced by only 15 percent there was a 5 percent increase in output, and that about one fourth less bodily energy was burned up in doing the typing. There are two remarkable things about these findings.

THE fact that so small a decrease in noise by absorbing it with wall panels resulted in 5 percent greater output is probably due to the unreduced noise intensity being just above what may tentatively be called a critical level; that is, before the 15 percent reduction the noise in the test chamber may have been at the point in intensity where it produced



THE AUTHOR

Standing outside Colgate Psychological Laboratory where many researches concerning industrial efficiency are conducted

ficulty in living at his previous zest in the hotter surroundings. If he and his descendents remain there long enough, however, they may become as fitted for the torrid conditions as are the natives.

With noise, conditions appear to be somewhat similar. In our present civilization noises have been increasing by leaps and bounds, and there is not much indication that they are going to decrease spontaneously. Can human beings adapt themselves to noises without suffering ill effects?

This may be a very vital question for the future of the race. The civilization of the United States would undoubtedly slump greatly if our climate were suddenly to be changed to that of the Panama Canal Zone; several generations would probably be needed for the inhabitants to adjust



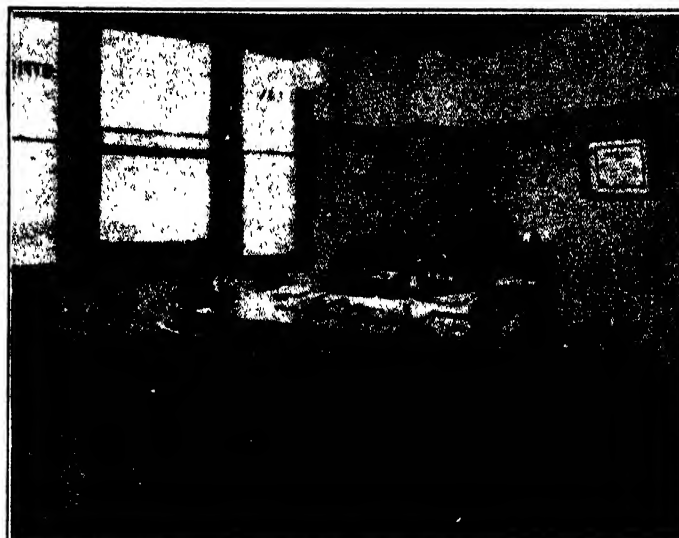
HOW MUCH NOISE ENTERS A WINDOW?

An experiment to determine the effect of outside noise, performed at Stanford University. The man in the foreground fires a revolver and the intensity of sound is recorded inside the room



HOW NOISY ARE MACHINES?

Checking up on noisy machines in the Hawthorne plant of the Western Electric Company, using an audiometer to measure the noise



A NOISE-PROTECTED OFFICE

A special window ventilator cuts off most of the outside noise, a rug absorbs inside noise but the bare walls largely offset the benefit

ill effects. This is indicated by the fact that reducing the noise still more did not affect the output figures. Apparently there is a critical point in the intensity scale of noises above which the fear reaction and possibly other effects are found, and intensive experimental work is being undertaken in the laboratory to discover these critical points for various noises and individuals. So far the indications are that most city and office and factory noise intensities are above this critical point.

The second remarkable finding is related to the consumption of about 25 percent more bodily energy, due to working under the noisier conditions. The energy consumption in calories was determined by collecting exhaled air and analyzing it for oxygen consumption, carbon dioxide production,

and total volume. Dr. John J. B. Morgan, of Northwestern University, discovered a few years ago that when typists were working under noise they exerted increased pressure upon the typewriter keys. This would not, however, account for an increase in energy consumption of the body of the magnitude we obtained. The difference is therefore due to the fact that under the noisy conditions bodily energy is dissipated by a general tenseness of all the muscles of the body. This is the exact reverse of relaxation and is fatiguing, and it saps energy unnecessarily.

In order to obtain standards of noise intensities for duplication in the test rooms in the Colgate laboratory, a survey has been made of noises in Chicago, Boston, and New York. Subway trains have been discovered to be

the noisiest means of travel, the noise being equaled only by an unmuffled airplane motor.

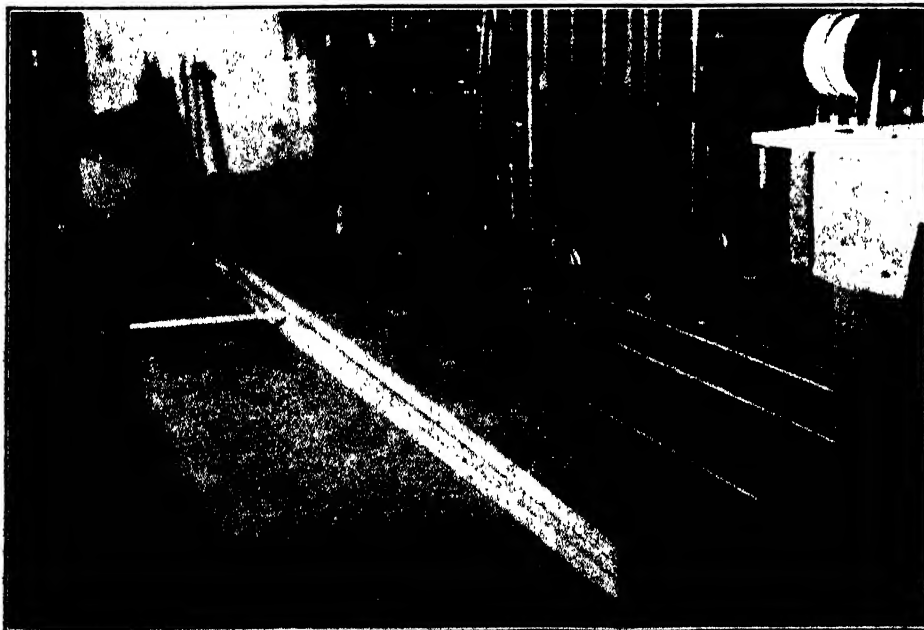
Until about two years ago it was not possible to measure noise intensities. The intensity of illumination from sources of light has been measured for years in foot candles, but until the Bell Telephone Laboratories developed the audiometer which was used in our surveys, no similar practical means existed for measuring noise. This instrument measures noise intensities on a scale from 0 to 100, 0 being a just inaudible intensity, and 100 an intensity great enough to make the ear drum tingle on the verge of pain.

We have found very few places where people work that are below an intensity of 50 units. The laboratory noise intensity that cut into the output of typists by 5 percent and into rigorous mental work such as executives think they do by 30 percent, was of a noise intensity just below 50 units.

IN a shopping section such as State and Madison streets in Chicago, the average intensity is 60 units, although at times during the day it went to 50 as a low mark. At times the intensity reached above 70, when surface cars were passing.

Surface and elevated cars contribute the most to city noises. Busses, automobiles and taxis yield around 50 noise units. Horse-drawn drays are almost as noisy as surface cars, especially if they are being drawn over brick or cobblestone paving.

Subway trains make a racket of from 75 to 80 noise units—about 10 or 15 units greater than surface cars. This is rather severe on passengers, but does not contribute so much to street or office noises as the surface cars, since most of the subway noise is kept below ground.



LOCALIZING NOISE MADE BY MACHINERY

Less noise is transmitted from this printing press because of a special mounting constructed of wood and noise-absorbing material. This cuts off direct vibration from transmission to the floor



HOW NOISY IS FLYING?

Taking an audiometer on a hydroplane at the Great Lakes Naval Training Station

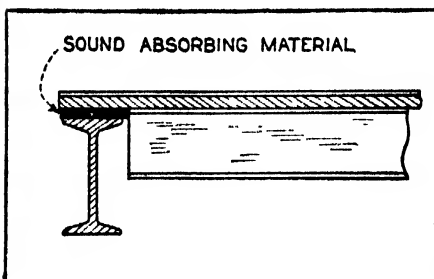
Some factory operations subject the workers to a continuous noise of 85 units. Intensities such as this are inexcusable in plants, for they could easily be reduced to a considerable extent by employing practical methods which will be pointed out shortly.

Most city dwellers are "innocent bystanders," so far as noise is concerned. No matter how quiet one attempts to be, noise will pour in through an open window, or even filter into the house or office through the crevices of the window. In a courtroom on the eighth floor of the County Court Building in Chicago, for example, with the window closed and no noise being produced in the room, an intensity of 25 units was recorded at the judge's bench. With one window half open this intensity was instantly raised to 35 units—an increase of 40 percent! The intensity of 25 units with the windows closed was not due to surface cars, as the window exposure was toward a street with only motor traffic.

OUR present American civilization is noisy, not only because more machines are being used, but also because the type of building construction now used tends to *prolong* and *transmit* noises. A bare plastered wall, for example, reflects noises better than a mirror reflects light. If you clap your hands together in a bare plastered room, more than 95 percent of the noise will be reflected from the wall. The sound of the hand clap will therefore persist for several seconds. This phenomenon of reverberation causes noises to be built up and retained "alive" in a room in such a way that their intensity is actually increased. If you clap your hands more than once, the noise generated by the second clap will be reinforced by the "reverberatory ghost" of the

first hand clap, the ghosts of the first and second reinforce the third; and so on until in the right kind of room (which, in fact, is the *wrong* kind) one person applauding himself can equal a whole audience.

If rugs are placed on the floor the reverberations will be cut down greatly. Further, if the walls were to be covered with heavy velvet drapes, absorption would be great enough so that the sound energy of each hand clap would

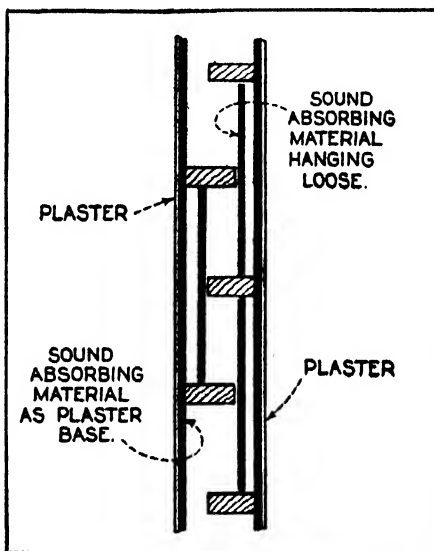


BUILDING FOR QUIET

Transmitted noises and building vibration can be cut down by this type of construction

be promptly absorbed and turned into minute quantities of heat and the hand claps would stand out in sharp individual staccato, not producing the mild roar they did in a reverberant room.

The practical control of noises does not consist in trying to keep the children quiet and in throwing out modern machinery, but largely in having an adequate amount of sound absorbing materials in work and living



BATHROOM PARTITION

Plan view of studding and walls. Studding should rest on sound-absorbing material

rooms. In many instances, however, noises can be cut off at their source, as by oiling a squeaky hinge, weather stripping a window that rattles, or adopting street cars with roller bearings and aluminum bodies which are quieter than the old construction.

In acoustical engineering the open air is taken to represent one unit of

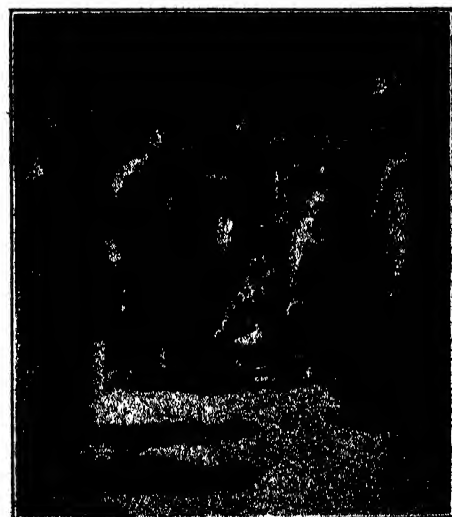
noise absorption per square foot. As soon as the subway trains of New York come out into the open air at about 125th street, for illustration, the noise the passenger hears is immediately reduced by more than 18 percent, due alone to the absorption of the open air.

The noise absorption value per square foot of common materials, an open window being taken as unity (for example, one person in a room has an absorption value equal to that of 4.7 square feet of open window) is as follows:

Plaster	.08
Varnished wood	.03
Linoleum	.08
Glass	.027
Concrete	.015
Carpet rugs	.20
Brick wall	.082
Cretonne cloth	.15
Akoustilith (artificial stone)	.36
Hairfelt two inches thick	.40-.60
Insulite, half inch thick	.31
Flaxlinum, one inch thick	.55
Acousticalotex, one and one half inch thick	.70
One person	4.7

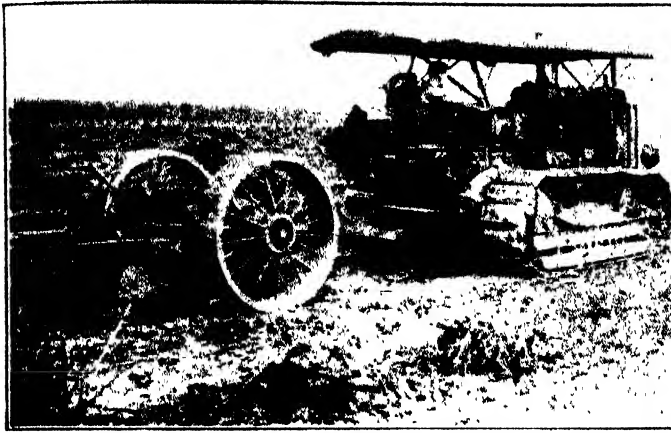
Much noise can be kept out of a home by the use of window ventilators designed to keep out noise while air is still admitted. Locating the house so that it is off the beaten path followed by trolleys and motor transportation also adds a restful quite.

NOISE that is transmitted through floors and walls of a building can be reduced only by special construction in which floors are floated on absorbing material and by the generous use of noise absorbers, as suggested by the preceding table.



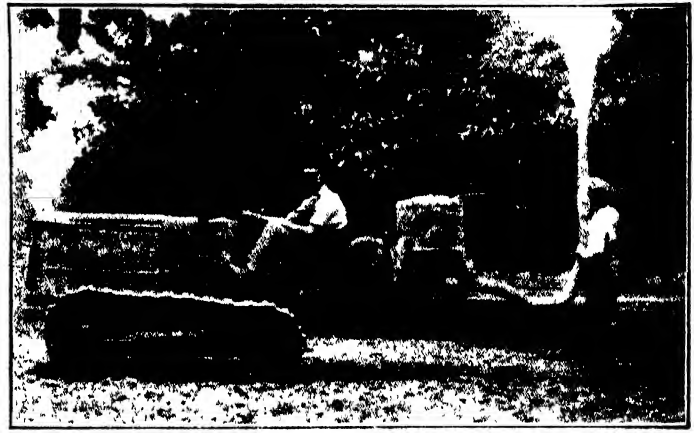
CHICAGO NOISE

With an audiometer, the noise on a busy corner in Chicago is being recorded



CUTTING AND UPROOTING OLD GRAPE VINES

This attachment cuts old grape vines 18 to 24 inches below the surface and pulls them out. Its record for one afternoon is 3300 old vines



DUSTING FRUIT TREES WITH INSECTICIDE

Equipment developed for attachment to the tractor that does the regular work of cultivating. It can be attached or removed in a few minutes

Engine Ingenuity

Novel Means Have Been Devised for Using Tractors to Lower Costs

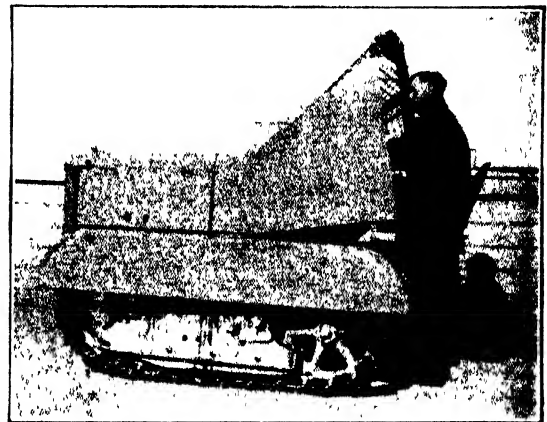
WHEN tractors first began to lift the load of labor from the shoulders of the farmer, they were used only to plow and pull a combination harvester. They replaced only a few of the horses. Since then, however, their adaptability to other tasks has led to their use for belt work, cultivating, seeding, and practically every kind of farm work. Many clever ways have been devised for making the tractor do not only the horse's jobs but also many that the horse cannot do, or that are too big for him.

In asparagus fields, a powerful tractor pulls a special pulverizer that leaves the soil in powdered condition. A tractor draws special machinery that ridges the soil and does the seeding in spinach fields. The ridging is necessary so that furrows may be flooded. Fruit trees are dusted by the same tractor that does the regular cultivating and plowing. In Mexico, Señor Don Angel Torres plants sugar cane by

tractor power. Two furrowers dig the trenches, two spouts convey the cane joints to a depth of 20 to 24 inches, and two men feed the cane to the spouts. Grubbing rocks is a common chore for tractors. Loose stones are dragged away by chains while imbedded ones may be loosened by a subsoiler.

One planter built a closed cab on his tractor for protection from wind and the dust stirred up by operation in the field. Another built a shield on his in order to protect the driver from overhanging branches. Mr. M. P. Brooks of California operates a tractor equipped with bean cutters capable of cutting six rows at a time.

The first time around a rice field with a pulled binder flattens much rice. To prevent this, a push binder has been developed. Libby, McNeill, and Libby have developed a new type of subsoiler drawn by a tractor that



AN ARMORED TRACTOR

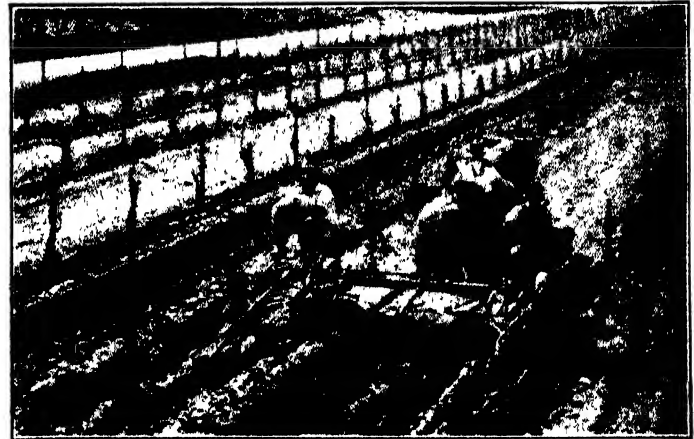
Shields for the driver and tractor treads to allow work under low-hanging branches of trees in citrus groves

straddles the rows of pineapples on their large Hawaiian fields. The subsoiler breaks the soil to a depth of 18 inches. Chisel cultivators, clod breakers, uprooters, and other special types of machinery, drawn by tractors, have been developed for use in vineyards. In one large vineyard, a tractor is used to haul cars loaded with grapes. What appears to be a locomotive is a tractor on flanged wheels operating over a narrow-gage track. These and a variety of other farm chores are now being done by tractors.



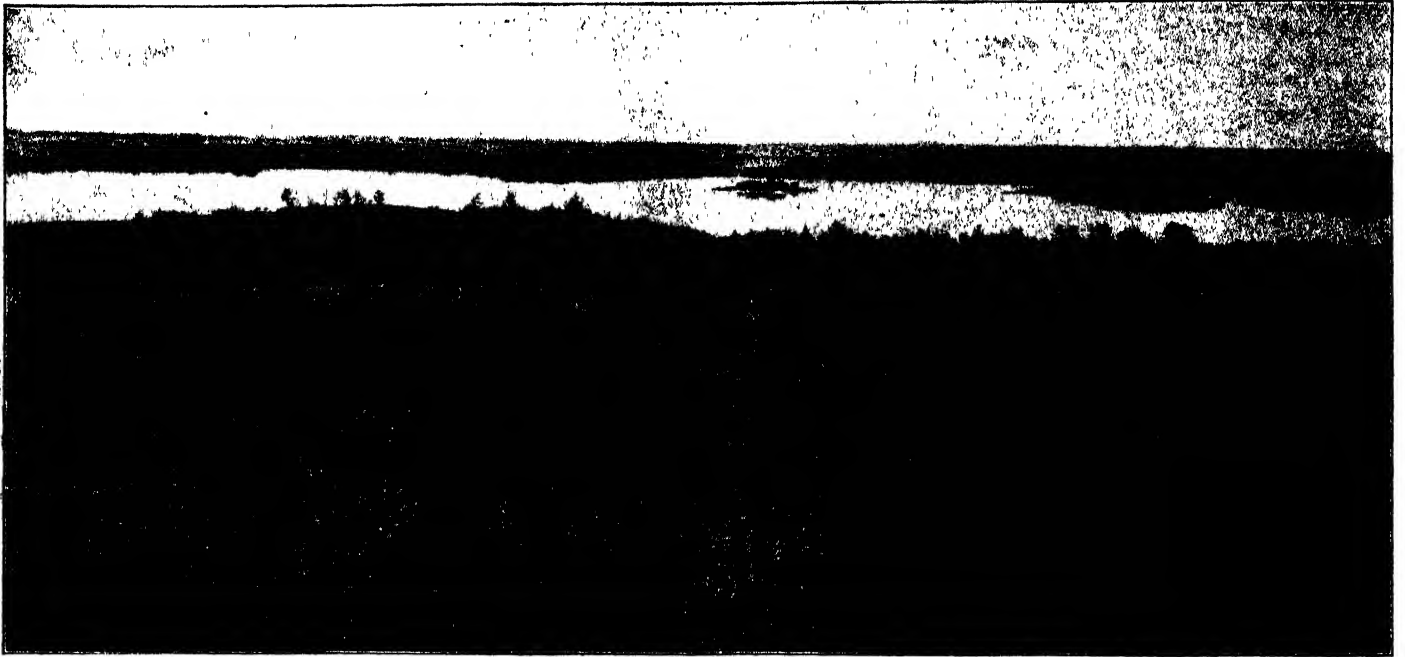
GETTING RID OF STONES

Sometimes rocks are loosened by a subsoiler or a heavy chisel; sometimes a chain is attached and they are towed away by a powerful tractor



PLOWING A TWELVE-FOOT ROW

A two-way plow with a "middle buster" and four 10-inch mold-boards at each side controlled by extra men. It is used on a California ranch



WHERE ONCE THEY ROAMED IN THOUSANDS

A small herd of animals in Buffalo National Park, Wainwright, Alberta. To avoid congestion in this relatively small park, several thousand buffaloes have been moved in the last three years to the Fort Fitzgerald district and released to mingle with the wild herd

The New North

Will Canada's Immense Northwestern Area of Untouched Prairie, Forest, and Tundra See the Next Great Wave of Economic Development?

By E. L. CHICANOT

THE economic north of the American continent is periodically changing. At one time it was held to stop short of the international boundary between the United States and Canada, and authorities dogmatically stated that there could be no worth-while production north of this. Now, with the great plains of the prairie provinces become one of the world's greatest agricultural territories consistently producing the world's prize wheat and accounting for an ever-widening diversity of crops, attention has come to center upon the Peace River country, 600 miles or so north of the Canadian border, (see map, at A) as being potentially a greater farming country. And already the eyes of economists are strained yet farther north and look right into the Arctic circle to see there a vast, rich, productive expanse of land.

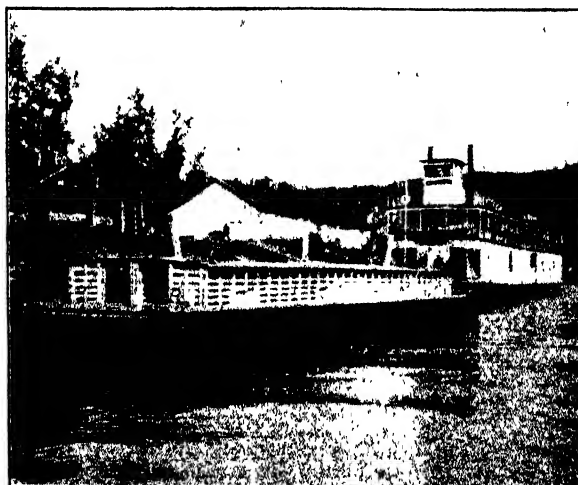
Canada, with as yet but a small population sparsely scattered over her broad domain, anticipates a time when what is regarded now as her economic

area will be adequately settled and productive and the search for new wealth and new methods of obtaining a livelihood will take men ever farther northward. The Dominion is making preparations for the development of her sub-Arctic wastes into a territory comparable in its productive capacity to others of her present divisions. It

pictures this now almost uninhabited vastness as the greatest preserve of herbivorous animals in the world, constituting a source of meat supply such as has never been known—an asset of tremendous national value.

This is not nearly as fantastic as it sounds. In fact it is eminently feasible. Because of the comparatively small amount of exploratory work which has been undertaken and the brief publicity this has received, the most lamentable misconceptions exist concerning this tremendous hinterland which penetrates above the Arctic circle and reaches almost to the pole. Popular imagination pictures it as a bleak, frigid, and barren territory, continually buried under snow and populated by a few scattered bands of Indians and Eskimos who take harvest of the furs, its one resource. That it might be a valuable adjunct to the rest of the Dominion of Canada has occurred to few.

As a matter of fact this region experiences bright and warm summers and produces a luxuriant vegetation capable of sus-



FOR BUFFALO TRANSPORTATION

The river steamer and scow used in transporting buffaloes from the railroad terminus to their new northern home

taining almost unlimited animal life. The rudest survey has revealed the existence of other resources, the extent of which cannot even be guessed. It is significant that the few men who have anything like an extensive knowledge of this region are most enthusiastic advocates of its conservation and development.

One of the obvious resources of this great area of which so little is known, one which has no place in the picture of snow-swept stretches, is its timber. Up to well within the Arctic circle are to be found quantities of spruce, tamarac, jackpine, poplar, larch, birch, and willow, all of good size and in commercial quantities. In the Mackenzie district (see map, at B) spruce attains a height of from 80 to 100 feet and logs have been cut averaging 40 feet long and 10 to 18 inches in diameter. The newsprint paper industry has already made a start upon the pulpwood supplies of the Prairie Provinces.

THIS vast territory has come rather more to public attention since the war. This is due to other phases than its Eskimos, its Indians, and its fur harvest. In the years immediately following the armistice, the search for oil in western Canada took drillers up into the Mackenzie River basin, well within the Arctic circle. There they were rewarded with a strike at Fort Norman, (see map, at C) 1500 miles north of Edmonton, which

is awaiting the transportation and other developments of the future. Following this, iron ore was discovered in the Mackenzie River basin and on the shore of Lake Athabasca (D) important finds which must await future



THE PICTURESQUE BUFFALO

Once near extinction, this animal with which American history is closely interwoven, is staging a come-back

utilization. The most desultory prospecting, carried out mainly by airplane, has revealed the mineral resources of the area as extensive.

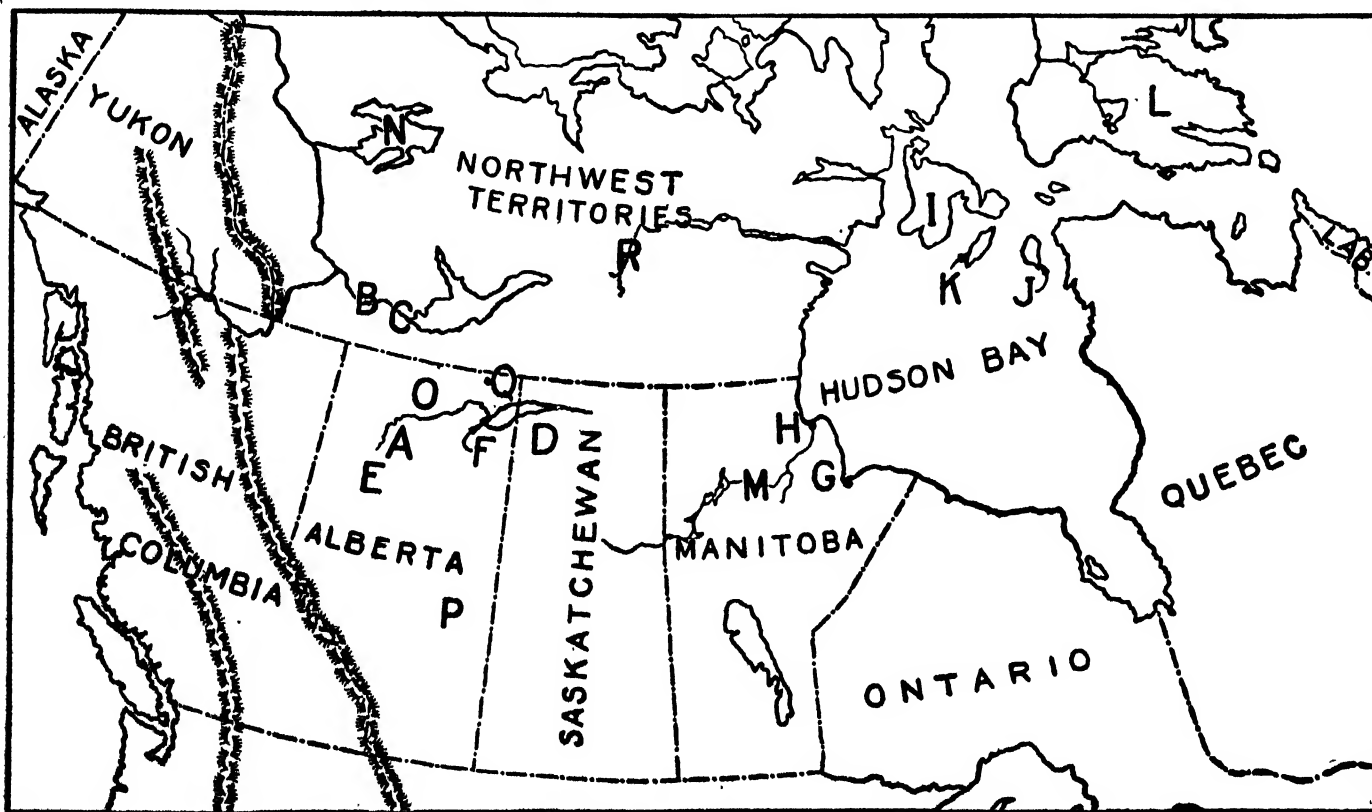
More recently, forcible attention has been drawn to the agricultural possibilities of the Far North. In 1926 the prize-winning wheat and oats at the Chicago Hay and Grain Show came from a point in the Peace River country, 600 miles north of the border. This recalled to memory the forgotten fact that in 1893 the prize winning wheat at the Chicago World's Fair came from the Shaftesbury Settlement, (E) 15 miles from Peace River Crossing, and that as long ago as 1876

wheat grown at a mission at Fort Chipewyan (F), to all intents and purposes within the Arctic circle, secured first prize at the Centennial Exposition at Philadelphia.

Just how far north the limit of successful agriculture will eventually extend one would scarcely venture to say, since it is very evident that the wheat belt is steadily being pushed northward. The evolution of marquis wheat at the time the Canadian prairies were first being settled, reduced the time between seeding and harvesting from 120 to 110 days and definitely expanded what was considered the wheat belt at that time.

THE development of garnet wheat which ripens 10 days earlier has, according to the best authorities, pushed back the northern boundary of agriculture from 100 to 150 miles, bringing all the meadow and lake country from Port Nelson (G) and Fort Churchill (H) to the Rocky Mountains within the dominion of the plow. Now Herman Trelle, Peace River wheat and oats champion at Chicago in 1926, has produced a wheat which can be sown later and yet ripens 18 days earlier than present varieties, thus thrusting the limit yet farther north.

Looking into the future, Canada believes the time will come when exploration and exploitation of the vast stretches even beyond the wheat belt will become necessary or advisable, and it is her conviction that the de-



WHAT WILL ITS FUTURE BE?

Will this great territory where wheat is grown in vast quantities, and buffaloes, musk-oxen, and reindeer are encouraged to multiply, become the factor it promises to be in world economics? There are a great many things in its favor. The text refers to the lettered areas



A POTENTIALLY HUGE MEAT SUPPLY

A herd of reindeer. Canada has followed the lead of the United States in introducing this animal as a meat producer. Already reindeer meat is being sold in many American cities

velopment of the varied natural resources of the territory will depend upon the existence there of a robust native population and an abundance of wild life. Accordingly, the Dominion is taking early steps to assure these, through the protection of those animals upon which the sparse population of that territory now depends, and also through the introduction of others which it has reason to believe will thrive there.

It was shortly after the end of the war that attention was forcibly drawn to the diminution of wild life in the sub-Arctic regions, strikingly indicative in itself of the increasing exploitation of that area. A government commission of trappers, Hudson Bay officials, mounted policemen, and other frontiersmen was appointed, and it is largely upon the recommendations contained in their report that the government has been working.

IMEDIATELY three islands in the northwest territories, Southampton (I), Mansel (J), and Coats (K), each with an abundance of forage, were set aside as perpetual breeding ground for herbivorous animals existing in the area, or those which might be introduced later.

The introduction of reindeer into the territory, especially after the successful experiment of the United States in Alaska, was recommended and considered. This, supported by the explorer Stefánsson who probably knows more about this region and its potentiality than any other man, stimulated private enterprise. One company brought in from Finland 700 animals to be grazed on Baffin Land (L), there to be attended by their Laplander shepherds. Another secured a Dominion concession of 75,850 square miles of grazing in the Barren Lands north of the Churchill River (M), and planned

to drive 1500 reindeer across from Alaska. These enterprises would appear to have proceeded without sufficient preliminary investigation and study, and their lack of success is believed to be due to a choice of territory deficient in the moss suitable for pasturage.

Authorities believe, however, that the project is feasible in the territory and the government is seriously planning to stock the Mackenzie River basin with reindeer, and is making most careful investigations to this end. The Porslid brothers of Denmark, men of wide experience in the Arctic, were engaged some time ago by the government to investigate thoroughly all conditions entering into the proposed attempt. They went into the north country in June, 1926, and did not come out again until the spring of

1928. They spent eight months investigating the reason for the successful introduction of reindeer into Alaska and worked down the Mackenzie River and Great Bear districts (N), comparing conditions with those of Alaska. Should their report to the Dominion Government be favorable, 2000 reindeer will be introduced into the area.

In the post-war period, the government's efforts at developing great meat producing herds in the far north were aided from a most unexpected direction. In 1921, a government survey party in the uncharted areas of northern Alberta (O), encountered a herd of several hundred buffalo, an animal which was believed to be extinct in its wild state. Steps were immediately taken to protect them, and their range grounds were declared a sanctuary. A park of some 17,300 square miles in extent was created, cabins erected, and wardens were appointed to supervise and protect them.

SUBSEQUENTLY a brilliant solution to the problem of congestion in the domesticated herds of the national park in Alberta occurred to the government which had for some years been killing off a number of animals each year to keep the herds down to reasonable proportions. It was decided to transfer a number of young and vigorous buffaloes raised on the reserve, to the wild sanctuary and turn them loose with the untamed buffaloes there. In the past three summers, some 7000 animals have been moved, at considerable expense and tremendous trouble, by train and river barge over the hundreds of miles from the Wainwright Park (P) to Fort Fitzgerald (Q) on the Peace River and turned loose to mingle with



CORRALLED AWAITING SHIPMENT

When it came to shipping the buffaloes to new locations where they would have a greater range, many problems were encountered. Here the animals are kept until a full shipment is gathered

the wild herd there. The government reports the experiment a complete success, rangers declaring the animals to be in excellent condition and their numbers increasing.

It is possible to look confidently forward to the steady increase of these northern buffalo herds until their expansive ranging grounds will reproduce to an extent the conditions which the pioneers farther west found. Under this protection a vast source of meat can be built up. Even before the transfer, when the overcrowding of the national park necessitated an annual slaughter, buffalo meat was on the Canadian market from coast to coast in competition with beef, and it is not too much to anticipate a time when this food of America's pioneers will be feeding not alone millions of Canada's future population but other millions far beyond its confines.

PROBABLY the most valuable animal of the sub-Arctic regions is the musk-ox. While the development of the buffalo herds was formerly problematical, and that of the reindeer still is, to some extent, there is no question as to the adaptability of the musk-ox to the region or of his superior value.



FOR FOOD AND CLOTHING

The musk-ox is invaluable to the region since it provides both food and clothing. Canada has established a sanctuary for this animal which is one of the hardest of the meat-producing animals

He is peculiarly and essentially an animal of the sub-Arctic where he has always thrived and can be expected to thrive indefinitely under adequate protection. The musk-ox is, in fact, one of the most wonderful and potentially useful of the Dominion's big game ani-

mals, being huge and strong, exceptionally free from disease, and capable of defending himself against all the menaces of the wild except man. Its flesh is excellent and its pelt extremely valuable. The splendid ability of the animal to rustle food through the winter obviates the semi-annual migration which allows other big game animals to be attacked by their enemies and renders them difficult to find, as is the case with the caribou.

The musk-ox is invaluable to the area, since it provides both food and clothing, and is certain to be an important factor in the development of the territory.

RECENTLY a sanctuary for this animal was established in the valleys of the Hanbury and Thelon Rivers, (R) east of the Great Slave Lake. This area contains 15,000 square miles encompassed in a district 200 miles long and 75 miles wide. This special section was selected because it has been reported to contain some of the remaining musk-ox herds and is without trading posts or permanent residents, being, in fact, a sort of no man's land between the Indian and Eskimo hunting grounds.

Under the plans that are being gradually elaborated and due to the enforcement of rigid protection, a new and a great north is developing. The vast sub-Arctic tundras which have long been regarded as desolate wastes supporting only a few scattered Indians and Eskimos who live precariously upon the fur harvest, are being transformed into a great food preserve. It is believed to be destined in the future to compel world consideration as a new economic division. Possibly some day it will be as renowned for its meat as the area to the south is famous today for its wheat. Some day perhaps, it will supply the world.



HARDY HERDSMEN FOR HARDY ANIMALS

The United States first introduced reindeer into Alaska a few years ago. The small herds of those early days have multiplied so rapidly that now there are several hundred thousand of them



TYPICALLY DOMINICAN

Photograph typical of forest life, vegetation, and rocky stream beds of the tropic island

ON a calm morning in November, 1493, the sudden, rapid dawn of the Indies found Columbus and his little fleet close to a rugged, volcanic island in the Caribbean. This came as no surprise to the great navigator, for the story has it, that during the previous night he had ordered the ships to proceed under very light sail, and had issued unusually large portions of food and water to his grumbling crews. So accurate had his calculations been, that he had made this windfall at the very time he had planned to do so; and so it came to pass, that on this soft, glowing morning, the towering, jungle-covered mountains, with their caressing rain clouds loomed purple and blue and emerald before the astonished crews.

NO more beautiful sight had these rough adventurers ever beheld. A gem of loveliness was before them which must indeed have softened even their battered senses into appreciation. At any rate, Columbus himself saw the glory of this isle. He sailed around it, but did not land at first, fearing the fierce Carib cannibals; and then because of the day, he reverently named his prize Dominica.

Hundreds of years afterward, fate brought me to Dominica also. That first time, I saw but an hour of her, but that brief visit cast a spell that filled me with the strongest emotion for this island, and filled me also with a desire to penetrate into those mountain jungles and rain canyons, to explore her caves and volcanic fissures. There, too, were strange, living creatures, with

still stranger secrets regarding their lives and adaptations.

All, undoubtedly, was exactly today as it had been hundreds of years before, when Columbus sailed around the island. I could, then, allow myself the privilege of discoverer, at least as far as these secrets of the wild were concerned, and so after years of hoping and planning I found myself at last in the heart of this paradise, surrounded by magnificent forests and jungles, living in the cool shadows of cloud-capped hills and mountains, lulled to sleep by night to the songs of tumbling streams and brooks, bathed alternately by day with tropical sunshine or deluges of warm rain drops, and always inspired by the strange songs of new birds and the beauty of my surroundings.

The name Dominica became meaningless to me for everything, almost, that I found and investigated possessed a strange or unique story. Thus in my mind it gradually became "Anomaly Island," and thus it remains.

EVEN the first white men who set foot upon this land found to their amazement that the Caribs were divided as regards their language. Thus the men spoke quite a different tongue from that of the women; and here was an anomaly at the outset.

We know now that originally Aruac Indians peopled these islands. They were not a very powerful or war-like people and were doomed to a strange fate. When the fierce Caribs commenced to explore the seas beyond their mainland homes in South America they naturally found the islands, which we call the Leewards, and considered them rich and easy prizes. As they always practiced extermination of the men upon any conquered tribe and took their women for their wives, it is easy to understand the dual linguistic condition the explorers found. The point

of greatest significance is, however, that this fact which so bewildered Columbus and his men proves very plainly that the Aruacs must have been conquered by the Caribs within the lives of the existing generation.

Coming back to the present, we find that the Caribs were never conquered by the whites. They still occupy a reservation on their beloved island for which they fought so valiantly and with their king, Jolly John, who is a personal friend of the author, they live peaceably but unconquered. And thus we record another anomaly.

WHEN one observes carefully the astounding vegetation of this island, realizing that here is to be found every type of plant from moulds and lichens up through the ferns to flowering plants, and that the forests, with their giant trees and endless parasitic forms are among the most magnificent in the world, it seems almost incredible that such an array of living things could have sprung into being upon a mass of inhospitable lava such as the island must have been in the beginning.

Even today there are fissures in the mountains that breathe forth bitter fumes, while a great boiling lake steams and sputters in the mountains, giving certain proof of the real nature of things below the surface. There are in Anomaly Island no rocks or minerals as we usually think of them. Streams cut their way down through boulder-studded lava and volcanic debris, but

all this material is comparatively soft: that is the whole secret of this jungle that has grown to such glorious maturity.

Lichens, those strange flat rock plants, are the forerunners of soil. They thrive upon the soft boulders of Dominica, sending their microscopic rootlets into the tiniest cracks. Here they grow and expand and pry off minute fragments of the mineral matter. In

Anomaly Island

Strange Animals Adapted to a Unique Environment Give the Picturesque Island of Dominica Its Peculiar Local Color

By PAUL GRISWOLD HOWES

Curator of Natural History, Bruce Museum, Greenwich, Connecticut



JOLLY JOHN

King of the Carib Indians, and a firm friend of the author

turn, their bodies die and rot and thus are mineral and organic matters combined in a preliminary soil that will support ferns and other higher plants which cannot live on rock alone.

Dying and rotting, dying and rotting, always after life and growth—thus is the soil built up. We must remember also that rain plays its part. It helps the rotting process and its carbonic acid gathered from the air helps to dissolve the rocks or lava.

IN Dominica there is a tremendous annual rainfall, probably 300 inches in the highest mountains. Soil forms quickly and vegetation thrives in the humid warmth. Rotting and return to the earth is very rapid under these conditions. Thus has the thick rich forest soil been brought into existence upon the bare lava of the island.

Along the coast of the island and 150 feet above the level of the sea I found marine deposits in the cliffs, proving either a former uplift of the land or the subsidence of the sea. In these deposits were the shells of both univalve and bivalve mollusca, fragments of spiny lobsters and much coral.

Among the snail shells was one spiral variety of small diameter. It was quite numerous in these deposits and the specimens were well preserved, many of them quite perfect. Later on, after settling down to work in the interior, I found this same species of snail alive, and quite common as a land species! Could it be that here we have a marine species that has survived an uplift, and because of the tremendous rainfall and almost continuous moisture upon the ground, has survived and adapted itself to a true terrestrial existence?

At night the forests are a strange medley of sounds which issue to some extent from tree frogs, but chiefly from the insect army. One fellow that I sought for weeks, called the "Black-smith" by the natives, possessed the most wonderful powers of ventriloquism. His notes were pure and musical, like the fall of a hammer upon a silver anvil. At length I found him, a big brown tree cricket producing these



EATING A DINNER LARGER THAN HIMSELF

A veritable monster of the insect world: a Hercules beetle eating a banana. In life, it is about twice this size and is a flying beetle, its wings making a sound, in flight, like a distant airplane

clear tones by means of a sort of file and sounding board situated upon his tough wings.

To my oil lamp at evening came the huge, blundering Hercules, great beetles whose wings in flight produce a tone similar to that of a distant airplane. They fought fierce battles with their powerful, lobster-like projections and ate bananas so completely that I could find no leavings. True to the spirit of their island of anomalies, the females possessed no unusual features at all, and reversed the usual sexual procedure by hunting out the males for themselves.

THERE are mantids or "animated stick" insects which lay masses of beautiful pink eggs, resting upon their elbows while so doing, while among the insects which are partially luminous at night there is one, a big beetle—I hardly dare tell it—that possesses two perfect oval headlights and a tail light in addition. When they crawl upon the ground the illusion of tiny automobiles scurrying about is quite perfect.

Another strange insect is a butterfly with orange colored wings. The female possesses scent glands with the odor of banana oil. These have been given to the insect for the special purpose of attracting the males, and if one of these butterflies is captured and squeezed very gently she will thrust out her precious glands, filling the air with her strange perfume. Soon afterwards a male will appear from the forest or trail, then another and another, until there are a number of rivals competing for the lady.

Even the fishes that live in the mountain streams of this island I found to be queer fellows. They have no choice in the matter, for conditions are so strange that they have become strange creatures also. In many cases these streams

are only rain carriers, which roar and tumble today but tomorrow may be all but dry if no rain happens to fall. Fishes are able to exist in such places by means of special adaptations which have evolved with their environments.

The spotted goby is a remarkable example of one of these fishes. It lives in streams which often become quite dry in the sense that water does not actually flow, although the sand and stones of the stream bed may remain damp. When the stream stops flowing, the goby goes into the damp sand and breathes atmospheric air. A specimen kept in a tiny aquarium without any vegetation to oxygenate the water, lived successfully for a long time, sticking its nose out of water when it required air.

Another condition which this goby must meet is that of too much and too violent water, as is the case in these streams directly after a deluge in the mountains above them. At such times the force of the water would sweep the fishes down into the sea, but another remarkable adaptation takes care of this in the form of a powerful suction disk, situated under the fish, and which it may use to fasten itself securely to a stone beneath the raging water until the danger passes.

I THINK perhaps the strangest of Dominica's wild children is a tiny species of forest frog. The frog itself is not so extraordinary, but in its life history, which it became my privilege to unravel, we have the most remarkable case of adaptation that I have ever seen.

Most young frogs are tadpoles and require a pool of some sort in which to swim and grow to the perfect state, but this little creature of the tropical islands emerges directly from its egg into the world as a perfect, but very minute frog. The tadpole stage may be traced within the unusually large eggs which have been developed by nature to supply sufficient food substance for the entire metamorphosis.



IT LIVES IN HOUSES

This terrifying creature is the harmless gecko, a lizard that lives on insects in Dominican houses



AN ANIMATED STICK

A Dominican mantid laying a mass of its peculiar pink eggs, resting on its "elbows" during the process. Note the malevolent glare it bestows upon the camera while the picture is being taken

The eggs are deposited upon the damp forest floor and here they lie until the young frogs emerge.

In this particular island, although blessed with a tremendous rainfall, there is really no place where tadpoles could live successfully. There are almost no forest pools because the land is so steep. The rivers are too swift and the streams contain too little food, and so with water on every side the species has found it necessary to evolve into one that eliminates the aquatic stage altogether.

AMONG the higher forms of life that inhabit Dominica, are some very strange and interesting things. Reptiles are very common although limited in species, and the smaller brown and green anolis lizards live in the houses as much as they do outside. They have learned that the lamps which man burns during the evening act as splendid lures for their insect prey. Lizards that come into the houses are assured of food at all times.

The newcomer to Dominica might easily be upset by the truly frightful geckos which prowl about the walls at night. They are often pale and ghostly in color and their great eyes add to the horror of their looks. They are harmless and friendly creatures that have also come into our headquarters to

collect their share of insects that are attracted by our lights.

If a gecko is attacked he instantly and purposely snaps off his tail with a sudden violent motion. The creature now crawls off slowly and cautiously while the tail, due to muscular reactions, thrashes violently about, attracting far more attention than the real main body of the lizard. Thus the geckoes are enabled to escape their enemies in a remarkable manner.

It is a strange and interesting fact that no poisonous species of reptiles occur in Dominica, although the island of Martinique, which is near enough to be seen on clear days, supports numbers of the deadly *fer-de-lance*. Isolation has of course accounted for many strange developments that have taken place and also for the limited life which the explorer finds there, yet it is hard to understand why this snake has not reached Dominica.

NOT many species of birds inhabit the island, but individuals are numerous and the mountain forests are filled with song. Despite the fact that only about 55 species have ever been recorded, it boasts the imperial parrot, one of the largest of the family and a bird which has never been found anywhere else in the world. Here we have an island approximately 30 miles long and 15 miles wide, a mere speck in the world, upon which a unique bird holds forth. They are always difficult to obtain, as they nest in holes in tall trees that are all but impossible to climb. They are well protected by the government of the Leewards, which is a very fortunate thing. However, a single specimen was brought back for the New York Zoological Gardens by the author.

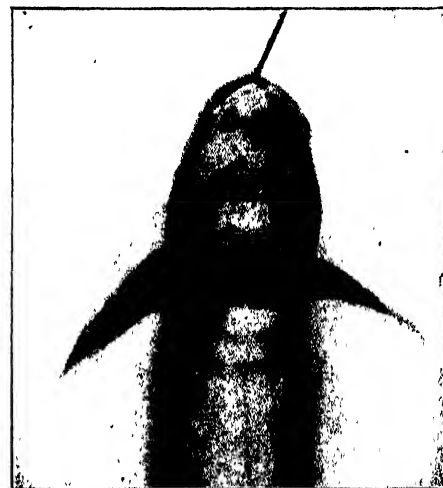
How this parrot came to evolve in Dominica, if it actually did, is a mystery that will never be certainly cleared up. In the opinion of the author it is a mutation from a mainland species that possibly inhabited the island at some former time. The older form died out, leaving the imperial species which is found today.

Bats are the dominant mammals of the island. Like the birds they reached the islands easily enough from the mainland with their powerful wings, but after arriving, because of peculiar living conditions, they developed curious adaptations.

IN one of the foul crevices explored by the author high in the mountains, tiny bats were found in great numbers, living in a dark hole in the earth that belched out a warm foul breath that a man could bear only a short time. Descents were made into this damp and fetid hole to collect and study the animals which were living in it without any apparent harm to themselves.

The gases of this fissure caused dizziness and a swollen feeling of our heads, and wherever in the semi-darkness we dropped rocks, a long and significant interval would elapse before the dull thud in the depths would inform us that bottom had been reached.

Dissection of these bats showed glands connected with the nostrils, which undoubtedly have something to do with their ability to inhabit their strange and unhealthy homes.



BELLY OF THE GOBY

The suction disk with which this peculiar fish clings to rocks during flood periods

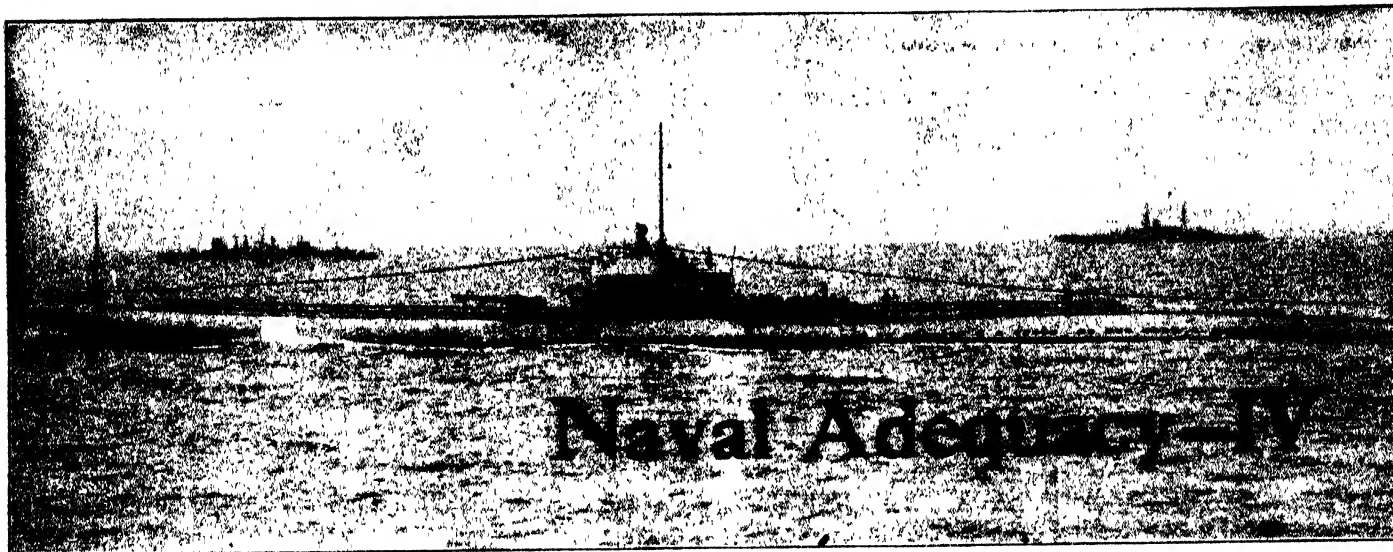
Many other varieties of bats wing over and through the great forests of Anomaly Island. Some are small and delicate, others huge, red-furred, winged creatures with a wing spread of two feet or over, with rasping tongues and strange fleshy nasal appendages for purposes still unknown.

Some scientists have scorned the smaller islands as places for study, because of their proximity to the far richer mainland of South America, yet where there is life as interesting and as remarkable as that which I have begun to investigate in Dominica, why go farther afield for the sake of mere numbers? These islands shall be my playground and laboratory for a while yet, for who can say what the future will reveal from the still unexplored wilderness of the interior?



FROG'S EGG

Greatly enlarged to show the tiny frog within. He issues forth perfectly developed



A FLEET SUBMARINE

The V-2, one of our new "V" type submarines, which are capable of long periods of battle operations with the fleet at sea

Balancing Our Fleet as Suggested by the Navy Building Program, Together With an Agreement for Further Limitations, Will Insure Against War

By CAPTAIN N. H. GOSS, U. S. N.

HAVING examined the conditions that exist in regard to bases, essential types of ships, and the fleets of men-of-war that are possessed by the principal naval powers, with particular reference to the present relative position of this country, the question naturally arises as to what might best be done to remedy the defects that already exist and to strengthen our navy to a position where it would become a reliable instrument of national defense.

TO do this it is necessary to discuss in some detail what has already been done by this and other countries following the Washington Conference, and particularly to discuss what was proposed at the Geneva Conference in the summer of 1927, and, following the failure to come to an agreement there, what has further been proposed in this and other countries. This leads naturally into a consideration of the recommendations—which have since come to be known as the Navy Building Program—submitted to Congress by the Navy Department when the 70th Congress convened in December 1927. From a reference to the chart of "Fighting Ships Built, Laid Down, or Authorized Since the Washington Conference," it is at once apparent that there has been a great deal of difference between the new construction programs of Great Britain and Japan, compared with ours.

The two new plane carriers, our principal construction during the period, were really ships that had already been laid down, whose conversion to plane carriers was expressly provided for in the Washington Treaties. In the nearly seven years that have now elapsed since the Washington Conference, six fleet submarines and eight cruisers constitute really our sole additions during

that period. Furthermore, the cruisers were not authorized until after both Japan and Great Britain had actually laid down very comprehensive programs of additional cruisers.

It should be remembered that the Washington Treaties left full latitude in building of naval craft beyond the two types that were expressly limited—that is capital ships and plane carriers; and decided that, in building other types, each power was within its rights to pursue a policy of strengthening what it might regard as its own interests.

REFERRING again to the diagram, we see that Japan has laid down and authorized a program embracing all the principal types permitted, and has, from her point of view, very properly decided to use the money, saved by the cancellation of her paper program of eight capital ships, to construct large numbers of the cruisers, submarines, and torpedo craft that she considered desirable to balance and strengthen her standardized capital ship strength. She now has what is undoubtedly the strongest submarine force afloat, composed as it is almost exclusively of modern vessels, adequate in size to operate far beyond the natural defensive limits of her home area. She has also a formidable, modern destroyer force and, considering her interior lines, a very strong cruiser force—all largely built since the Washington Conference.

Despite the general British preponderance in auxiliary types, they too have laid down or authorized an exten-

sive program since the Washington Conference, particularly, it must be noted, of light cruisers. Despite their overwhelming strength in this type, they have laid down and authorized no less than twenty-four additional vessels of well over 200,000 tons. They have also materially modernized their submarine force by an addition of twenty-five new vessels.

IN the meantime, we have not seriously attempted to replace our obsolete tonnage in either cruisers or submarines. In connection with such replacements, it is to be noted that the Washington Treaties did fix an age limit on capital ships, limiting the time before which they may be replaced. Fixing the age of that type at twenty years seems a wise and logical thing, since it makes possible the gradual replacement of vessels that have grown obsolescent or worn out, by later classes within the prescribed total tonnage limits, that is by vessels that are modern and embody later improvements and ideas. It is only natural, too, that there should be a disposition to apply this same system to other types, particularly since the smaller and more complicated vessels such as submarines and destroyers wear out or otherwise deteriorate very quickly. The total tonnage idea seems the logical one, rather than the limitation of numbers, since it permits different powers to adapt the size of their units to their own needs and base resources.

Following this precedent established for capital ships, an age limit of twenty

years for cruisers, sixteen years for destroyers, and thirteen years for submarines, based on experience as to about when such vessels need to be replaced, seems a reasonable one.

So, we find that, in 1927, the United States, actuated by a desire to forestall or remove competition by fixing a limit to the remaining principal types of war craft, invited the other powers to another conference for the limitation of naval armament which met at Geneva. Limiting these other types seems particularly desirable, for, unless they are limited, naval competition may still take place, and it is a matter of history that the spirit of rivalry and distrust engendered by such competition may be one of the principal causes of war. A recent example of this may be seen in the rivalry that existed between Germany and Great Britain previous to the World War. Since each side was unwilling to compromise or to agree upon a limitation of dreadnaughts, successive increases in German naval strength brought about corresponding increases by the British with resulting strained relations that, undoubtedly, constituted one of the contributing causes of the war.

IN the belief that an agreement limiting all principal types would remove this competition and tend to lessen the causes of war, the United States accordingly sought at the Geneva Conference to extend actual limitation to cover these other types. It was only natural that we should seek to extend the principle of the 5-5-3 ratio which already applied to capital ships and plane carriers. If this were done, and sufficient tonnage were allowed in each type to permit naval powers to balance their fleets with sufficient numbers of ships to meet their own needs—with sufficient strength for requisite duties with the battle fleet, for commerce protection, and for communication duties—a condition could be achieved where each of these powers might have a fleet adequate to its legitimate needs and able to command respect for its national policies, a fleet sufficiently strong to constitute an effective fighting organization, yet definitely limited by treaty so that there would be none of the competition that has contributed to war in the past. Such an agreement including a prescribed age limit for individual vessels would permit each power to modernize its fleet by scrapping its older vessels and keep its fleet up to date by replac-

ing the older classes as they become obsolete.

At the time of the Geneva Conference, it seemed that the other powers might readily agree to such a proposal since they had already balanced their fleets by new construction following the Washington Conference, and since the British in particular had increased their capital ship strength by building the two new battle-ships permitted by the Washington Treaties. These two new ships which the British now have

These proposals, in effect, would not only have left them a cruiser strength far in excess of ours, since the cruiser tonnage we possess, with the exception of the ten modern "Omahas," consists of vessels that are entirely obsolete, and useless in comparison with their modern cruisers, but would also have limited us to a comparatively small number—not above twelve—of the 10,000 ton class which, as previously shown, is the size best suited to our needs. Actually, the effect of this proposal would have been more far-reaching still, because, since only this large class could mount eight-inch guns, all other cruisers would, not only automatically but specifically as well, be limited to guns no larger than six inch, which guns could also be mounted on most vessels of the vastly predominant British merchant marine.

THE British also proposed an age limit of eighteen years for the larger and sixteen for the smaller cruisers rather than the twenty already established for capital ships. There are reasons both for and against this proposal. It would permit keeping cruiser strength more up to date, more homogeneous, and would permit the British particularly soon to replace their cruisers built during the war. It would in the long run, however, add considerably to the expense of cruiser replacements.

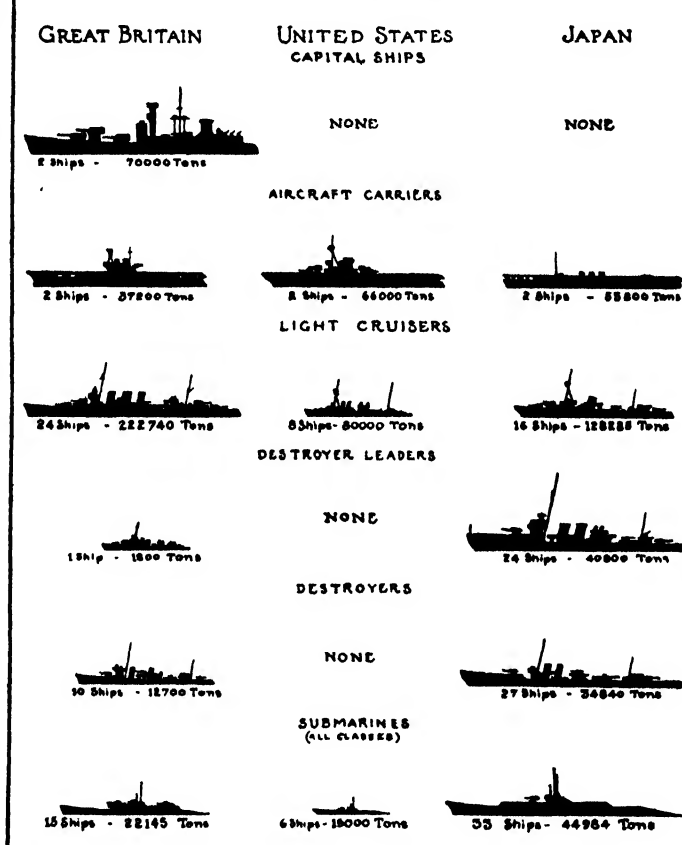
The British proposed later on at the Geneva Conference to make 6000 tons the upper limit of future cruisers, while at the same time exempting the cruiser strength already built. This would, of course, have left them not only a

predominant cruiser strength but, since 6000 tons is quite too small to be useful to us, also have augmented very greatly their relative naval strength due to the increased strength it would give to their merchant marine.

The Washington Treaties not only fixed the capital ship limits, but specifically provided the earliest date when existing capital ships may be replaced. They fixed 1936 as the time before which no changes in existing capital ship agreements should be made, and further provided that this country should call a conference at Washington in 1931 to discuss further extension of the treaties beyond 1936 and any other matter on the general subject of naval limitation that might arise in the meantime.

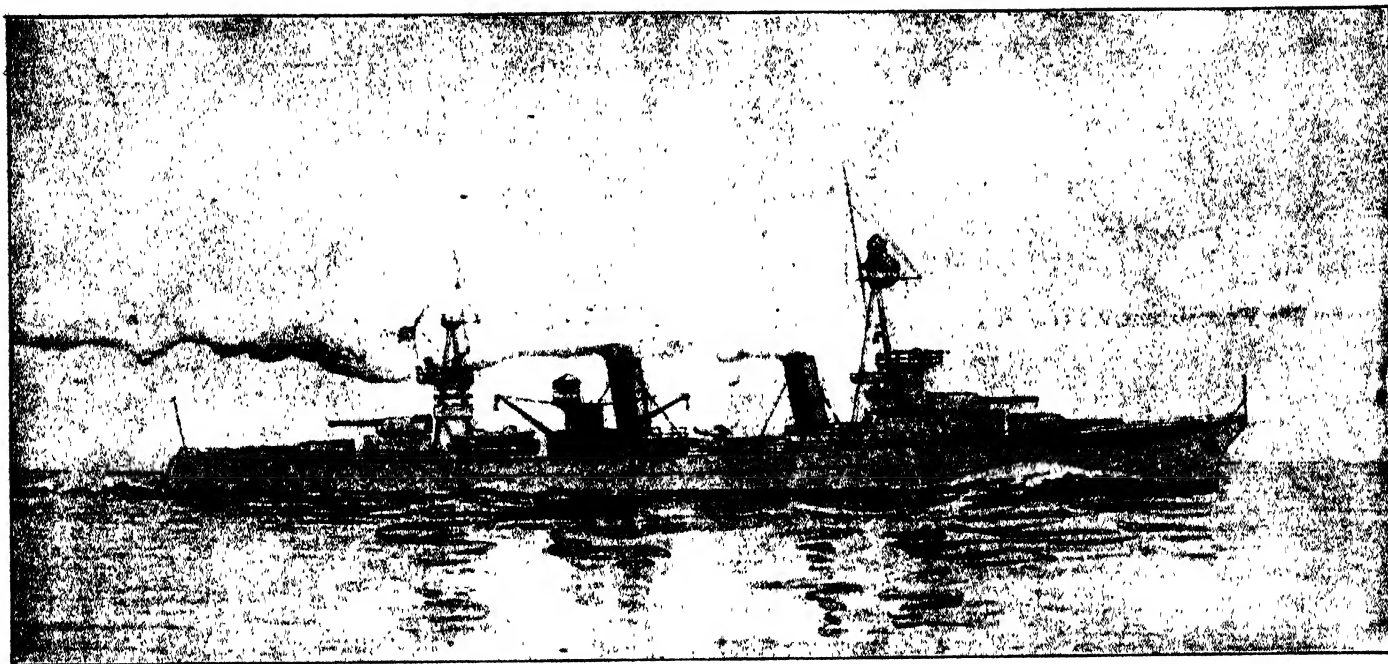
Notwithstanding this, however, the British included in their proposal at

Fighting Ships Built. Laid Down or Authorized since the Washington Conference



are the last word in design—are, in fact, the only capital ships designed since the war—are of the largest size permitted, larger than the battle-ships any other navy possesses, and carry more guns of the heaviest caliber allowed than are mounted on any other capital ships.

The British at this conference at Geneva seemed unwilling to apply the equality principle embodied in the 5-5-3 ratio to other types of vessels, particularly cruisers. They countered with a proposition that would, first of all, rigidly limit the number of cruisers of the 10,000 ton class, carrying eight-inch guns; secondly, establish a new size limit of individual vessels of considerably less tonnage; and finally, exempt from this limited total the very large force of modern cruisers which they already possessed.



CRUISER OF THE NEW "PENSACOLA" TYPE

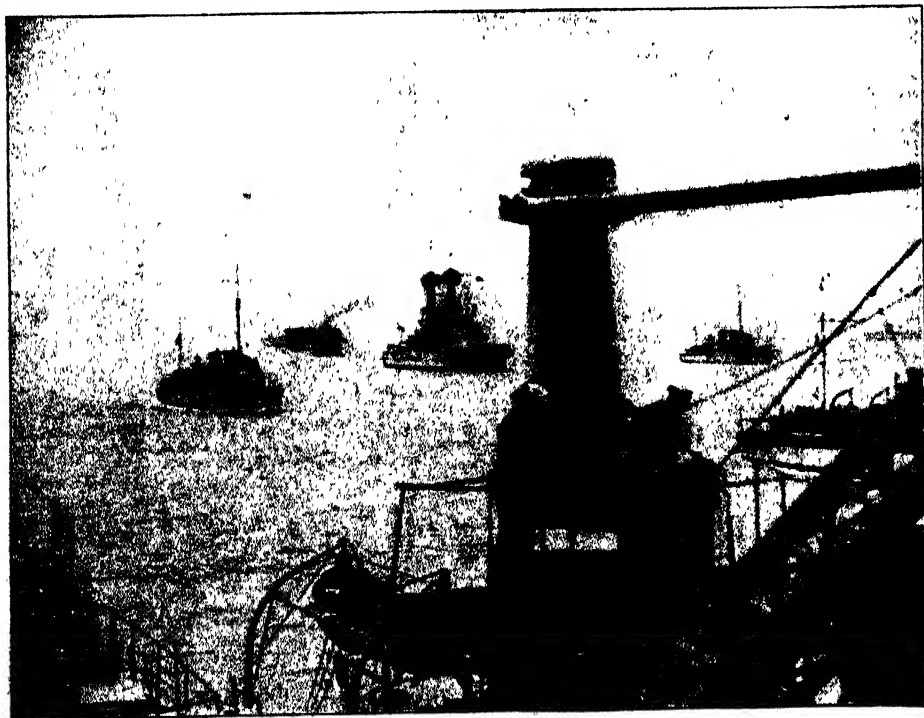
An artist's conception of the new class of 10,000-ton cruisers, a number of which are being built by the United States. The Navy Building Program outlines the need for more of this type instead of cruisers of the 6000-ton class proposed by the British at the Geneva Conference in 1927

Geneva a proposition to extend the age limit of capital ships to twenty-six years, to reduce their size limit to 30,000 tons, and reduce the size of turret guns in future capital ships to not above 13.5 inches. This proposal, if adopted, would materially diminish our naval strength. As has been shown, we are at present handicapped by lack of battle cruisers.

The treaty now provides that we may lay down two new capital ships in 1931 and two more in 1932. Presumably we would desire these to be of the battle-cruiser type in order to overcome our existing deficiencies in

that direction and some of the handicap we now suffer through lack of bases. Were the size limit reduced to 30,000 tons we would be unable to build any battle cruisers, since such size is too small to give these vessels both the high speed and the amount of protection that modern defense requires. It is easy to note also that such an extension in age limits would automatically extend the present advantage of the Japanese and the British—particularly the latter since they have the *Hood*, 12,000 tons greater than the new limit they proposed, and their two new 35,000 ton battle-ships as well.

The British advanced economy as one reason for this new capital ship proposal. Our proposal, however, for limiting the aggregate of cruiser tonnage would also effect very material economies, since the powers possessing base resources would be able to build the smaller and cheaper cruisers adapted to their needs, and do this gradually; and since competition would be eliminated there would be no necessity for feverish construction. It would not be wise to forget that any reductions in the strength of our capital ships would automatically increase the naval strength of the countries possessing large merchant marines and numerous bases, and would diminish correspondingly even our potential naval strength.



OUTWARD BOUND FOR ANNUAL MANEUVERS

The United States fleet leaving San Francisco for annual maneuvers in the Pacific. These yearly trials quickly show the lack of balance of our fleet and the need for more ships of essential types

THIS British desire to re-open the capital ship question was reiterated last spring at the short session of the preliminary conference, under the auspices of the League of Nations, looking to a limitation of naval armament. At that time the British again proposed extending the life of capital ships to twenty-six years, to reduce the size of their turret guns to 13.5 inches, and to reduce the size of future capital ships to something under 30,000 tons.

In connection with the British cruiser proposals, it is well to remember that since the Washington Conference, they and the Japanese have deemed it desirable to build the largest class of cruisers permissible, and particularly to remember that they authorized and actually laid down numerous vessels of this class before any were even authorized by us.

Divergence of opinion on the cruiser question was so wide at Geneva that no great amount of consideration was

given to destroyers and submarines, the latter partly because the French and Italians were not represented, hence any agreement materially affecting submarine strength could hardly be made without the accord of these powers, and since, rather logically, the British considered destroyer strength inherently involved with submarine strength, the destroyer being the latter's principal antidote. The British have consistently favored the total abolition of the submarine, because it is such a menace to them and, particularly since, in modern war, most vessels of the merchant ship type proceed as convoys operated by the federal government. Therefore they have largely the status of men-of-war.

SO we see that, at Geneva, the British were really not willing to discuss further limitation on a basis of equality. They proposed not only to keep the preponderant cruiser strength they already had, but also to limit rigidly to a small number the large class of cruisers that our base limitations require for us. It accordingly seems reasonable to believe that our proposals were better adapted to the preservation of peace, since we proposed nothing beyond the 5-5-3 ratio in actual vessels without any allowance for the inherently superior positions of other powers with regard to bases.

It seems that our basic idea was sound because we proposed merely to extend a system that would allow each nation a total navy adequate to its needs, and would leave each free to build the classes most suitable for itself, while at the same time removing competition and providing a condition of balanced strength by means of a tonnage limit on types. This would also, as before noted, permit the gradual replacement of the older classes of each type as they reach reasonable age limits.

In the previous discussion we have seen what deficiencies exist in our fleet compared with the other navies. We have also considered what this country desired to accomplish at the Geneva Conference. We will now consider what the navy has proposed to balance our fleet by supplying some of the existing deficiencies in essential types.

The public attention focused on the naval situation by the failure of the Geneva Conference gave the navy the opportunity it had long needed to interest the country in the needs of our fleet. These needs had existed increas-

ingly ever since the Washington Conference as our fleet fell farther behind in relative strength due to the building program of other powers. The country, however, had been too engrossed in other matters to consider seriously the needs of naval defense until our fleet's weaknesses were glaringly exposed at Geneva.

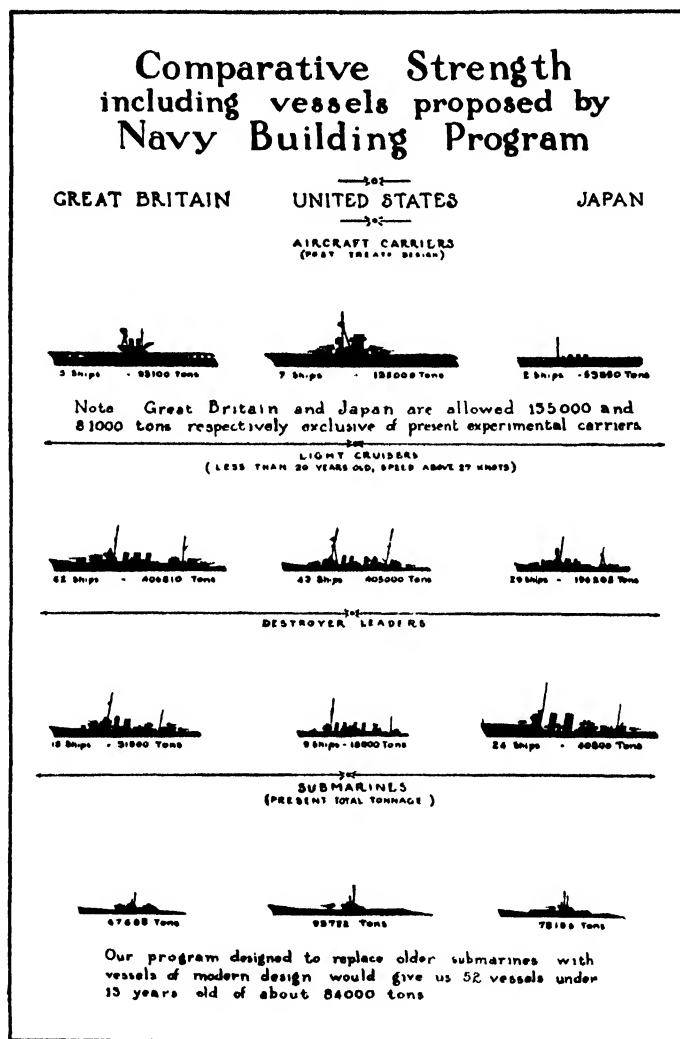
The need to balance our fleet by remedying deficiencies in auxiliary types has existed, of course, ever since the Washington Conference standard-

cruisers, nine destroyer leaders, and thirty-one submarines seemed large, but, by consulting the diagram of fighting ships built by the three principal powers since the conference, it is to be seen that while others have been carrying out large building programs, we have been building very little during this time. It is estimated that not less than eight years would be required to complete this program. If now we consider this as spread over fifteen years that must elapse since the Washington Conference until it could be completed, it will be seen that the average number per year will be quite small, or less than five vessels, in fact, including even the smaller types.

TO analyze the program in some detail; the five aircraft carriers are desired to complete the tonnage prescribed by the Washington Treaties for us; the destroyer leaders are desired to provide a type we now lack entirely. These are not desired to increase our total destroyer tonnage, since we have expressed our willingness to scrap down to an agreeable limit. The submarines are replacements entirely. They would give us a modernized submarine force of something under 90,000 tons—about 84,000—to replace the somewhat over 90,000 tons we now have. The light cruisers requested are not only needed to supply the deficiencies that have already been pointed out, but most of them, or 179,425 tons, are designed to replace present obsolete cruiser tonnage.

By examining the diagram of how the fleets would compare if our program were added, it will be seen that our program would in no way exceed the principle of the 5-5-3 ratio. It would not exceed the British cruiser strength; it would not equal the ratio of modern submarines already built or building by Japan; it would, naturally, not exceed the limits of plane carriers already prescribed by treaty. The only type in which we have an actual excess in tonnage is destroyers, and we have repeatedly offered to scrap all excess in these whenever the other countries will agree to a limitation of other types.

When we remember that war experience has shown that not more than one third of a submarine force could be kept at sea, even with the short distances that obtained in the European submarine zone, it can readily be seen that our projected submarine force of



ized capital ships, and our navy has been relatively weakened, naturally, by the large programs of these types built by the British and Japanese since that conference. When Congress convened in December, 1927, the Navy Department submitted for the first time a program devised by the navy itself as the responsible technical advisor. This has since become generally known as the Navy Building Program. It represented responsible naval opinion of what was needed to correct existing deficiencies in essential types and give us a fleet reasonably adequate to our needs. Since it was based on the 5-5-3 ratio principle of actual vessels, it did not presume to overcome our existing base deficiencies.

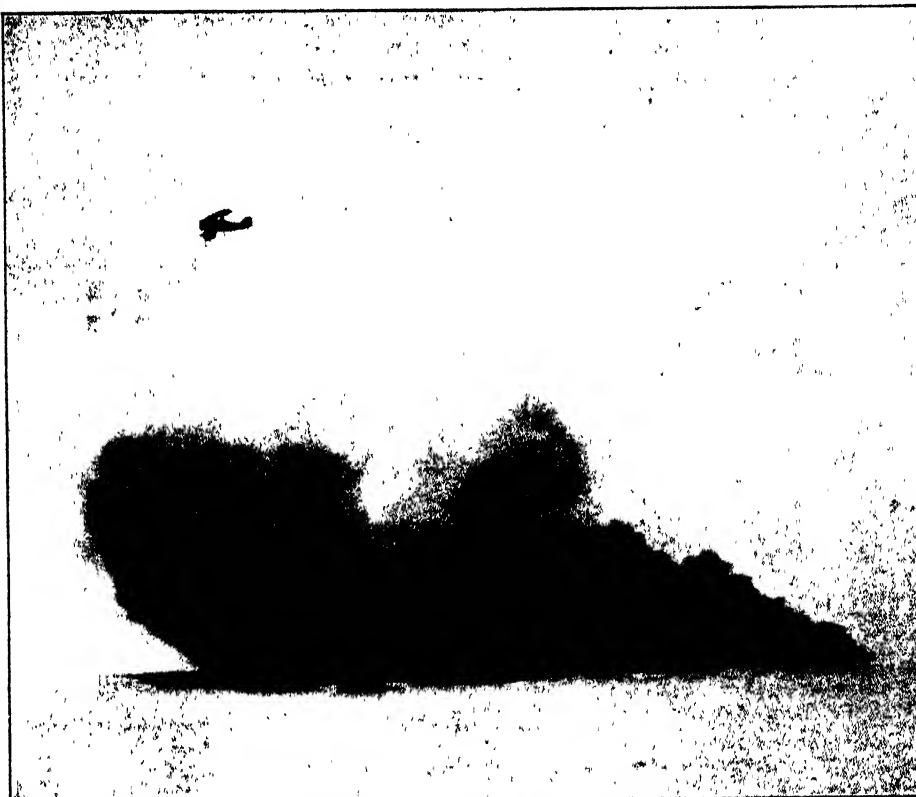
To some, this recommendation for five aircraft carriers, twenty-five light

fifty-two modern vessels could hardly be called excessive. From this we see that the navy's desire to eliminate existing deficiencies by building, within the limits of the 5-5-3 ratio, types that other nations already have, is not, in fact, a desire to start a naval competition.

The navy's program, it will be noted, would give us about the 400,000 tons of cruiser strength and the 90,000 tons of submarine strength needed to balance our authorized capital ship strength, and we have stated our willingness to scrap destroyers in excess of 250,000 tons.

THE navy has no quarrel with the British for advocating at Geneva what they consider their own interests, but desires only to point out that some agreement is necessary in order to avoid competition and unfriendliness. As previously stated, the limits should be sufficiently large to provide a force adequate for the individual needs of each country, but a cruiser force actually exceeding 650,000 tons, desired by the British, seems too large for reasonable needs and a source of too great expense. We, lacking the British base facilities but with just as important trade and commercial interests abroad and with our insular possessions at such great distances, feel, however, that about 400,000 tons of cruiser strength is more reasonably adequate.

The British have been more inclined to talk in terms of numbers than we. Their Admiralty experts, including



EFFECTIVE CONCEALMENT

A destroyer division at sea laying down a smoke screen. The "eyes of the navy," observation planes, are used to spy on enemy ships and spot gun-fire behind this rolling pall of black smoke

Lord Jellicoe, have stated their actual needs to be about sixty-three cruisers. Our responsible naval opinion has fixed our cruiser needs at about forty-three. If now we compare the tonnage of these

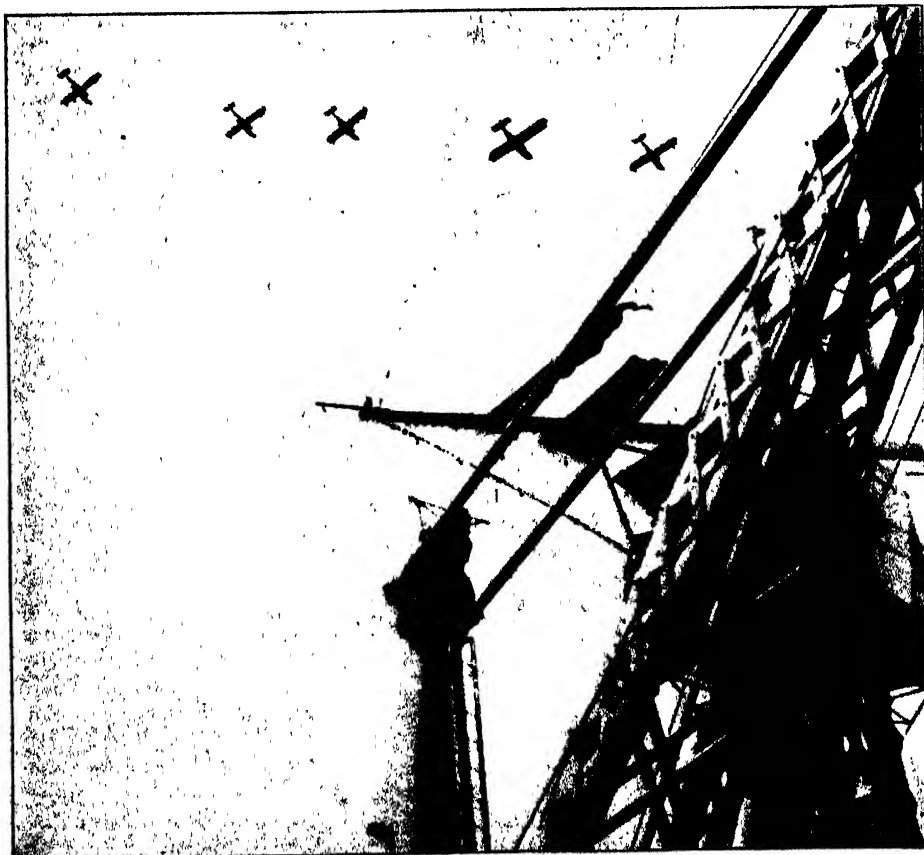
sixty-three cruisers with the forty-three desired for us we find that they actually amount to about the same in each case—around 400,000 tons. It seems therefore, that a basis of agreement may actually be already in sight. Such an agreement would be an example of how much better it is to base an agreement upon actual needs rather than an arbitrary figure.

A SOLID basis for peace is a force adequate to needs, yet limited. Unless it is limited, sooner or later competition will arise with the dissension, suspicion, and distrust that are contributing causes to war.

It has been said that a fleet is an instrument of policy, but it will not be an effective one unless adequate. Without an adequate fleet there is no way to check the aggression of others. With it we could pursue our non-aggressive way without interference.

Proposed congressional action on the Navy Building Program includes present authorization for only a part of the program, namely, fifteen cruisers and one plane carrier. While a material step towards bettering our present condition, this will not remove the other deficiencies that exist or give us a navy adequate to our needs. Lack of adequate preparation for defense cost us twenty billion dollars in the last war.

Modernizing and balancing our fleet along the lines suggested by the Navy Building Program, coupled with an agreement on limitation of all essential types, is the surest way to prevent another war.



AN OBSERVATION SQUADRON PASSES

A squadron of planes passes over the fleet. The two airplane carriers, our principal construction since the Washington Conference, carry many planes and allow extensive observation flights at sea

The Month In Medical Science

A Review and Commentary on Progress in the Medical and Surgical Fields

By MORRIS FISHBEIN, M. D.

Editor of the Journal of the American Medical Association and of Hygiene

Executive Health in Industry

IN 1919, the president of the Dennison Manufacturing Company decided to institute health supervision for the executives of that group. He realized that practically everything in a factory is inspected and examined regularly to prevent waste and to maintain the equipment of the plant in the highest possible state of efficiency. The key men of any industry are responsible for its progress or failure, and the executives are the key men.

The president of the corporation called in his personal physician, whom he authorized to adopt the plan. The physician visited many other industries throughout the country, studying various types of health supervision. He finally worked out a plan which involved yearly examination of 50 of the major executives of the company. These examinations were not compulsory, but after the matter was explained to them by the president, all of the executives decided to take advantage of the opportunity.

In 1921, eighty minor executives, including department heads, chief clerks and foremen were given opportunity for examination. Dr. Halstead G. Murray has recently told of the results of the work thus far. Among the 80 minor executives, 28 major defects were found in the first examination, including disturbances of the heart, varicose veins, skin diseases, hemorrhoids, and ruptures. Minor defects included overweight and underweight, bad vision, defective hearing, decayed teeth, infected tonsils, high blood pressure, low blood pressure, and flat feet. At the time of the examination record is made of the health habits of each individual and he is informed as to correct personal hygiene. Such surveys indicated many opportunities for correction.

It was soon found that the examination gave opportunity for the application of several modern ideas in preventive medicine. Hence inoculation against communicable diseases, three weeks' vacation annually with salary, special half-holidays in the summer in addition to the Saturday half-holidays, and special vacations for men who required them because of overwork, became a part

of the plan to keep executives in the best physical condition.

The executives now like the health examination, co-operate fully, follow the advice given to them, and willingly correct minor and major physical defects when these are called to their attention. The directors of the corporation feel that health supervision has shown worth-while results, sufficient to justify its continuance.

Imitation Cod-Liver Oil

SINCE the information has become available that cod-liver oil is the richest substance known in two of the important vitamins, namely, vitamins A and D, the latter being specific against rickets, all sorts of imitations of cod-liver oil are offered to the public with specious but unwarranted claims. Because of the lack of palatability of cod-liver oil, many attempts have been made to develop concentrates or tablets which would contain the important factors. Thus far the only tablet which has met the approval of the Council on Pharmacy and Chemistry of the American Medical Association is one known as Oscodal. Because of the difficulty of preparation the price of this product is somewhat high.

In the city of Salford, England, a large chain drug store offered for sale McCoy's cod-liver oil extract tablets. The city prosecuted the store for selling these tablets, since chemical and biologic tests showed that they did

not contain vitamin A or D. As a substitute for cod-liver oil they were therefore worthless. Investigation revealed that the tablets were made from essences manufactured in America, and that there were no official tests as to the vitamin efficiency of such products. As a result of this trial the British concern was fined 150 dollars and paid 375 dollars in costs.

It is important that anyone who takes cod-liver oil or who gives it to an infant should have a potent preparation. Nothing is so disastrous as to expect to prevent a disease, such as rickets, and with perfect confidence to give remedies supposed to be of merit, and then to find that failure has resulted because of inefficiencies of the products used.

Occupational Treatment of Disease

WHEN a person has recovered from a long illness, he is likely to be disturbed at life in general. He may hesitate to go back to work due to his inability to carry the burden, or it may be that the work with which he was formerly associated is no longer suitable to his physical condition, and that some new occupation must be found for him. The problems of occupation associated with the treatment of disease are included under the general heading "occupational therapy," for which organizations now exist in the United States.

These problems constitute a definite specialty in medical practice. Occu-



OCCUPATIONAL THERAPY SHOP IN A LARGE HOSPITAL



RESTORING USE OF LIMBS

The patient shown suffered with a broken back and paralysis. Daily work with the jig saw helps in the restoration of the bodily functions



IN BED BUT AT WORK

Bedside occupations add to the general morale of the patients and help to make many months of irksome confinement pass much more rapidly

pation in the treatment of disease has been divided by Harry E. Mock into three types: diversional, which is addressed primarily to the patient's mind; purposeful or curative, which is practiced not only to occupy the mind, but with the direct purpose of restoring proper function in certain nerves and muscles, and pre-vocational, which is work undertaken to teach the patient definite training for some trade or industry, thus helping him to provide better for himself after recovery.

Among various forms of occupational therapy commonly used in hospitals are the making of basketry, or reed and wooden furniture, mechanical training and carpentry. In cases in which the joints have become stiffened, the operation of a velocipede jig saw is useful; for ankle joint exercise, the foot pedal scroll saw and foot power sewing machines are helpful; for stiffened fingers and wrists clay modeling and the making of papier-mâché forms are advised.

The occupational therapist builds the handles of the saw, hammer and plane with wax in order to fit the deformity of the fingers that may be present. In cases in which the shoulder, elbow, or upper part of the back need exercise, basket and loom weaving are applicable. While the patient is doing these things he not only improves his physical condition but derives pleasure from the manufacture of artistic objects and perhaps forgets the pain which the exercise may cause him.

Skin Irritations in Gasoline Stations

MEN who handle great quantities of oil and gasoline not infrequently develop irritations and infections of the skin. Today thousands of men earn their livelihoods by working in industries involving such handling. Two types of inflammations of the skin are most frequent. One is the

irritation due to the action of the gasoline, benzene, and similar substances. Since these substances dissolve the fat, they take the fat out of the skin on the back of the hands and on the forearms, and set up inflammatory reactions.

As a result of repeated actions of this sort the skin becomes thickened, furrowed, and tends to peel off. Protection of the skin for even a brief period and the application of suitable dressings with oil or fat in them brings about prompt recovery.

It has been noted for some time that lubricating oils set up inflammations of the skin, permitting easy access of bacteria, with the production of boils and pustules. The lubricating oils serve to seal dirt and grime in the openings of the skin and thus to give the bacteria opportunity to grow and produce infectious matter. Here again the treatment depends on thorough cleanliness, removal of the contact with the irritating substances, and proper opportunity for the human body to take care of infections.

Americans Drink Less Tea

A RECENT report of the United States Department of Agriculture indicates that nearly six and a half million pounds less tea was imported during the year ending June, 1928, than during the previous year. This represents a decrease of 7 percent. At the same time there has been a considerable increase in the use of caffeinated drinks. The chief ingredient of tea from a chemical point of view is caffeine. This is a stimulating substance. Many persons have argued that it is inadvisable to stimulate the human mind and body repeatedly with caffeine, and as a result there has been a decrease in the consumption of tea and coffee and an increase in the use of decaffeinated coffee and of coffee substitutes.

It is an interesting point, however,

that all sorts of soft drinks which contain caffeine are increasing in soda fountain consumption. The public has no knowledge, of course, that these drinks have caffeine added to them and that the caffeine content is largely responsible for the stimulation felt.

Genius Transmitted Through the Mother

IN the *Deutsche Medizinische Wochenschrift*, Sanitätsrat Leven applied recent knowledge of eugenics and heredity to prove the point emphasized by many philosophers that genius and intelligence are inherited through the mother rather than the father. Schopenhauer cites as examples the fact that Alexander the Great and Caesar Borgia inherited their character and heart qualities from their fathers, and that Hume, Kant, Schiller, Goethe, and Walter Scott inherited their intelligence and intellectuality from their mothers.

It has been established by modern eugenic studies that sex differentiation is associated with definite chromosomes in the germ cell. The chromosome that carries the sexual character of the female has two definite components known as the x-chromosome and the y-chromosome. In most living organisms the y-chromosomes are inactive. In man, the male receives his x-chromosome from the mother, but the female receives her two x-chromosomes from the father and mother. As pointed out by Leven, psychic endowments are associated with the sexual chromosome. The male can inherit this chromosome only from the mother. He does not transmit it to his sons, but he does transmit it to his daughters.

It is, of course, reasonable that other factors may have to do with intellectuality. On the other hand, Leven urges that exclusive hereditary transmission of the x-chromosome to the male establishes a natural connection between genius and the female sex.

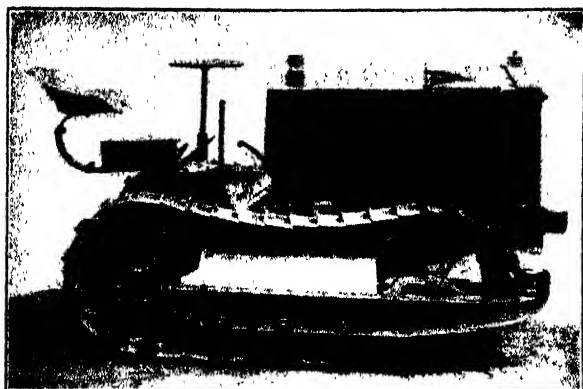


FIGURE 12

The tractor of the type illustrated is steered by differential track driving, as explained in the text

(Continued from October)

IN discussing the steering of two-wheeled vehicles, it is convenient to put them into two classes—bicycles and dicycles. In the dicycle, the two wheels have a common axis. Tractors of the Caterpillar type, (Figure 12), may be classed as dicycles, the pair of endless tracks taking the place of the wheels. The steering of dicycles is effected by differential drawing. In the caterpillar tractor there is a differential gear to equalize the propelling effort of each track. When running straight, each track makes the same number of revolutions per minute. When it is desired to turn to the left, a brake is applied to the shaft communicating with the left track which is thereby prevented from rotating. The whole engine motion and power is now transmitted to the right track, which, continuing to drive, makes the machine pivot about the motionless track. To resume the straight course, the brake on the left shaft has only to be released.

A SECOND method of accomplishing the steering is by interrupting the driving of either track by freeing a right or left friction clutch through which the power is transmitted to the track sprockets. With two separate engines fitted, one for each track, steering is effected by speeding up or retarding either engine or by

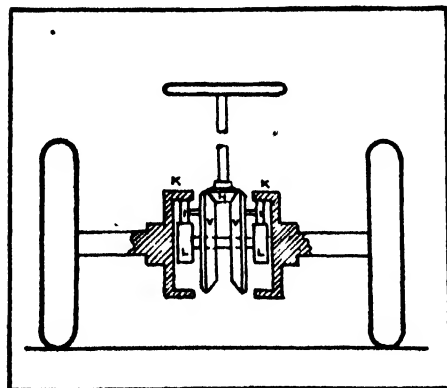


FIGURE 13

The Vedovelli-Priestley steering gear speeds up one of the wheels and retards the other one

declutching either engine.

The steering of the passenger dicycle was by the method first mentioned. In it, however, the differential was locked when running on a straight course; both wheels were then compelled to rotate with equal speeds, and the machine was not swerved by ordinary obstacles encountered by one or the other wheel. Such locking of the differential for straight running is not found necessary in the track-laying vehicle, for owing to the line contact of the track and ground, the difference in the resistance at the tracks due to ordinary road irregularities is not sufficient to swerve the vehicle.

If the front wheels of an automobile were converted into castor wheels, the car could be steered by manipulating separately the right and left rear-wheel brakes. The system could be used to supplement the steering as ordinarily arranged. A slight variation is used in the steering of a road roller with Caterpillar tracks and front steering wheels. The front wheel is steered by engine power from a cross-shaft which rotates the whole fore carriage by a chain. For quick turning, either track can be held stationary and the other driven around by means of multiple disk clutches inside the gear box and independent brakes working on the outer drum of each clutch to retard them as necessary.

TWO other modes of steering the dicycle may be noted. The wheels could be mounted on stub axles as on the front axle of a motor car, the swivel pins, however, now lying in a horizontal plane. This would permit of the plane of the wheels being inclined and steering effected as with the monicycle. If the swivel pins were maintained vertical, steering could still be accomplished, but it would not be possible to straighten out the machine after turning. It would be found, in general, traveling with one wheel ahead of the other, that a right angle turn of the wheels would transform it into a bicycle.

The second mode of steering the dicycle embodies the principle underlying the Vedovelli-Priestley differen-

Wheels—II

In this Installment, the Author Deals With Bicycle, Dicycle, Tricycle and Four-Wheeled Vehicle Steering

By P. CORMAC, F.R.C.Sc.I., M.R.I.A.
University College Dublin

tial steering gear, Figure 13. Assuming the steering wheel attached to the central bevel wheel, *H*, to be held stationary, both road wheels necessarily turn with equal speeds since one may be regarded as driving the other through the internally toothed wheel *K*, the planet wheel, *I*, and the sun wheel, *L*. The vehicle thus travels on

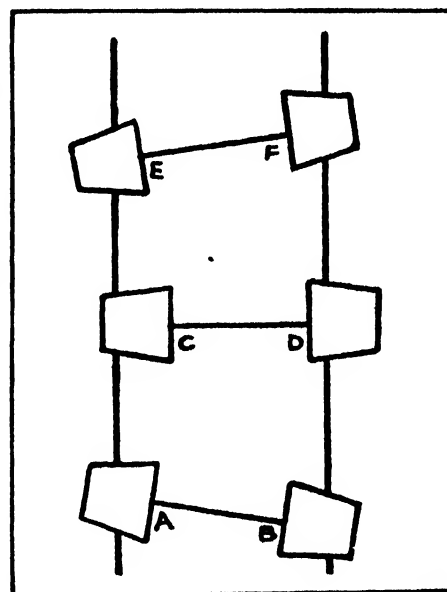


FIGURE 14

Coned tires on railroad wheels tend to keep wheels on the track without using the flange

a straight course. Turning the steering wheel rotates the bevel wheels *V*, *V*, in opposite directions and these, by carrying the pivots of the planet wheels *I*, *I*, around with them, superimpose a reverse speed $-S$ on one driver, and a direct speed $+S$ on the other. This makes one wheel rotate faster than the other by an amount equal to $2S$, so that one wheel over-running the other carries the vehicle around in a curve with the high-speed wheel on the outside. As long as the steering wheel is continuously rotated, the machine will run in a curve; when rotation of the steering wheel is stopped, the straight course is at once resumed. Here no such action as turning back the steering wheel for straightening out of a curve is necessary.

The principle of running a vehicle in a curve by having the outer wheel

over-run the inner wheel comes into play to some extent when a railroad locomotive is running on a curved track. It has been already noted, (See first installment in November issue. Editor.) that locomotive tires are coned. In rounding a curve, the outer wheel tends to run on the larger diameter and the inner wheel on the smaller diameter of the tire. The slope of the tire face gives about one quarter of an inch difference in the diameters. This, on the usual gage with three-foot wheels, would carry the locomotive round a curve with a 225 yard radius.

The over-running effect obtained by coned tires tends, in itself, to keep the wheels on the track without the flange coming into action at all. This is illustrated in Figure 14, and applies to a pony truck with a single pair of wheels when the pivot pin connecting it to the engine frame is not in front of the axle.

LET the axle with its attached wheels be running upwards; the motion will carry the wheels so that *B* runs on its larger diameter and *A* on its smaller diameter as shown at *CD*. The end *D* is now carried ahead of the end *C* owing to the greater distance traveled in each revolution by the wheel at *D*. From the position *CD* the axle will run to the position *EF*. The conditions are now the same as at the start, with the exception that presently the axle will be running on its larger diameter at *E* and its smaller

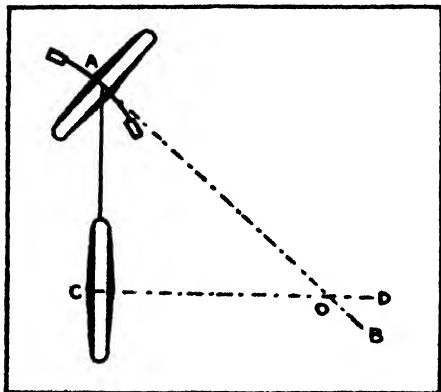


FIGURE 15

In bicycle steering, the machine turns about the intersection of the axes, AB and CD at O

diameter at *F* which will again run it back to the straight. Thus the axle pursues a sinuous path in its progress along the rails. A model to illustrate this action may be made by taking two corks and passing a knitting needle through them to form an axle. The assembly may be run down sloping tracks formed of two pieces of taut thread as illustrated in Figure 14.

THE principle of bicycle steering is shown in Figure 15. The front wheel can, without sideslip, run in a circle about any point on the line AB which is the axis of the steering wheel.



FIGURE 16

The bicycle steering wheel trails behind the trace of the steering column as shown by rod

The rear wheel can, without sideslip, run in a circle having a center anywhere on the axis *CD*. There is one point common to both *AB* and *CD*, so that this gives a unique center point about which the machine may turn without sideslip of either wheel; and this is therefore the point about which the bicycle turns. The track of the rear wheel is the circle center *O* and radius *OC*, while the track of the front wheel is the circle center *O* and radius *OA*. Since *OA* is greater than *OC*, if the front wheel clears an obstacle, the rear wheel will also clear it. This is an advantage of front steering which does not obtain with rear steerers. With rear wheel steering and a car alongside a curb, getting away forward involves turning the steering wheels so as to run them up on the curb, a procedure contrary to economical tire use and comfortable riding.

The fact that *OC* is less than *OA* explains why a bicycle or automobile can be maneuvered into a restricted area



FIGURE 17

The steering column of the "scooter" strikes ground behind wheel, giving negative castor

with greater ease when in reverse. To drive in between a pair of narrow gate piers off a narrow roadway may be impossible to do directly, but possible if the car be driven past and then reversed in. This is also the best mode of turning a car around on a narrow road.

IN the bicycle, the steering column is given a rake so that its axis strikes the ground a few inches ahead of the point of wheel contact. This is shown in Figure 16. In running, the wheel trails after the point on the ground indicated by the rod, so that obstructions encountered do not swerve the steering to right or left. This construction is equivalent to the castor arrangement of wheels on furniture. There is a difference, however, in that the furniture castor, with its vertical pivot, does not

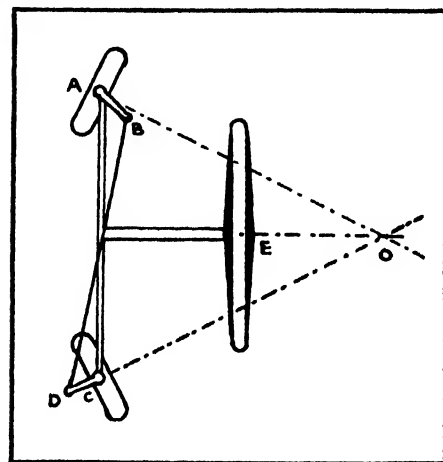


FIGURE 18

To steer a tricycle, all axes, prolonged, must intersect at some point, as is shown

alter the height of the center of gravity of the article as it turns, whereas turning the bicycle wheel lowers the center of gravity of the machine. This, in the bicycle, would tend to make the straight running position unstable were it not more than counter-acted by the action of the road resistance at normal speed on the castor setting of the wheel.

IT is worth noting that in the "scooter," Figure 17, there is what may be termed a negative castor effect—the steering column strikes the ground to the rear of the point of wheel contact. Following from this setting is the fact that turning the steering wheel of the "scooter" raises the center of gravity of the machine, so that the weight on the footboard tends to keep the steering wheel set on a straight course. This will be the predominating effect here, as, on a smooth road at the usual speeds, the action of road resistance on the negative castor in tending to swerve the steering will be less than the action of the weight in tending to keep it straight and thereby the "scooter" is made stable.

The steering of three-wheeled ve-

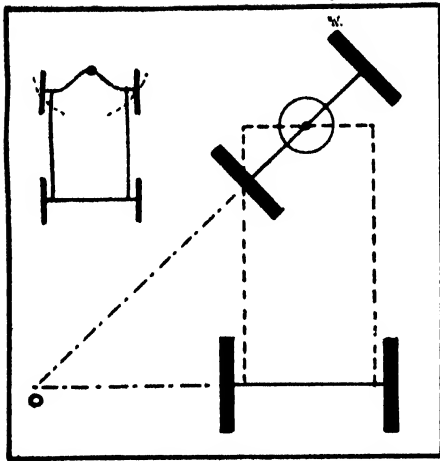


FIGURE 19

Mid-point or fifth-wheel steering is, as explained in the text, theoretically correct

hicles does not present any new problem as long as the two wheels not used for steering are on a common axis. The machine can, without slip of the wheels, turn about the point of intersection of the axis of the steering wheel with the common axis of the paired wheels. This of course holds whether the steering wheel be in front or rear. Tricycles and motorcycles with sidecars form common examples of this type of steering.

Occasionally in motorcycles, the sidecar wheel is set a few inches ahead of the rear motor wheel. In cornering with such a machine there must be slideslip of one or more tires over the roadway. The axis of the front steering wheel cuts the axis of the sidecar wheel and the axis of the driving wheel at two separate and distinct points, so that there is no center about which the machine may turn without skid of a tire. The setting is correct only for straight running and it automatically tends to keep the vehicle on a straight course. It is stated that the setting counteracts a drag on the steering due to the unsymmetrical position of the sidecar.

WHEN a vehicle has three separate wheel axes, at least two must be mounted as steerers, and mechanism must be furnished to turn the steering wheels in such a way that, in all positions, the three axes are concurrent, that is, they intersect in the same point. Concurrency of wheel axes is the geometrical condition which must be satisfied if there is to be no sideslip of tires when curving. If one of the wheels which turns in the steering sense be mounted as a castor wheel, the concurrency condition will be satisfied automatically without the use of a linkage to harmonize the deflections of the wheels. Such a castor wheel was used in conjunction with the two driver-steerer wheels of the Vedovelli-Priestly electric automobile already referred to.

A tricycle with three separate axes

is shown in Figure 18. The two small wheels are mounted to turn as steerers. Short steering arms AB , CD , connected by the coupler BD , turn these wheels in opposite directions so that their axes, AO , BO , intersect on the axis EO of the driving wheel E . The linkage shown accomplishes this approximately. A much more elaborate linkage would be necessary to give exact concurrency to the three axes in all positions.

THE difficulty in satisfying the concurrency condition in the case of four-wheeled vehicles is avoided by adopting what is known as mid pivot, perch pin, or fifth-wheel steering. This is the arrangement on horse-drawn wagons, steam road rollers, and on several types of steam road locomotives. In this system of steering, shown in Figure 19, the front axle pivots as a whole about its middle point. In all positions of the steering we therefore

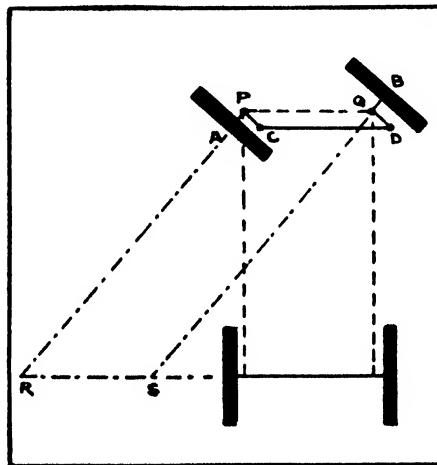


FIGURE 20

With divided-pivot steering, illustrated here, some skidding of the wheels must take place

get a single point O about which the vehicle will turn without any slipping of the wheels. The pivot is best placed slightly forward of the center of the front axle as indicated in the small diagram of Figure 19. This gives a castor action to the wheel pair; in horse carriages the advance is two to six inches or more. This is augmented by the set or rake of the perch pin which sometimes is pointed downwards and forwards some five degrees.

THE large effort required to turn the steering wheel, and the strain on the steering mechanism on account of the large lever arm of the unbalanced road resistance—the lever arm is half the wheel track—make mid-pivot steering an unsuitable system for high speed automobile work. A further serious drawback is that as the front axle is turned in cornering, the support for the car against overturning is reduced considerably. The defects of the mid-pivoted axle steering led Lenkersperger of Munich, to invent, in 1817, side-

pivot steering, Figure 20. This system as modified in 1887 by Jeantaud, a French carriage builder, is now in almost universal use in automobiles throughout the world.

With side-pivot steering, the two front wheels, Figure 20, are carried on short axes AP , BQ , called stub axes, which are pivoted at P and Z to a cross member, the so-called front axle. The pivots P , Q , are known as steering pivots, swivel pins, knuckle pins, or king bolts. Short arms PC , QD , forming bell cranks with the stub axes and called steering arms, are connected by a coupler or track rod CD . Lenkersperger placed the steering arms at right angles to the stub axes so that the length of the track rod was equal to the pitch of the steering pivots. In consequence of this, the steering linkage $PCDQ$, Figure 20, always formed a parallelogram, gave equal deflections to the two front wheels, and maintained the axes of the steering wheels parallel to each other in all positions. The steering-wheel axes therefore cut the rear-wheel axis in two points, R , and S . The wheel B would steer the machine around S , while the wheel A would steer it around R . Actually, the car would turn about a point between R and S , some skidding of the wheels, which is undesirable, taking place to permit this.

IT has already been noted that for correct steering to obtain, that is, for all wheels to run without sideslip of the tire on the ground, the plans of the road wheel axes must be concurrent. The correct conditions are shown in Figure 21. Here, the car by turning about O gives each wheel a path on which it may run without skidding. From the drawing it will be seen that the inner steering wheel must be turned through a greater angle than the outer wheel in order to give the necessary concurrency to the axes. The excess turning of the inner wheel may be as much as six degrees.

(To be Concluded)

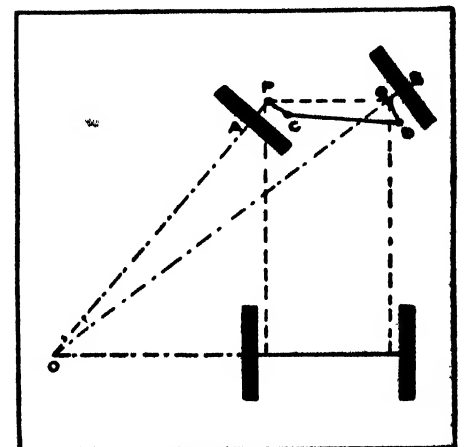


FIGURE 21

This modified form of divided-pivot steering gives more nearly accurate performance

**KNOTTY STUMPS**

Stumps and chunks of hard stone "wood" in the petrified forest in Sonoma County, California

"QUEEN OF THE FOREST"

This immense petrified redwood which bears the above name is 80 feet long and 12 feet in diameter. The trunk has been split by a tree which sprouted through it and grew to large size

A Monumental Stone Forest

IN the foot-hill country near Mt. St. Helena, 45 miles northeast of San Francisco, there is a prostrate forest of trees which, due to petrification, serves as its own monument. Lying with their tops pointing away from Mt. St. Helena, these giant stone trees tell of a very ancient magnificent forest that was overwhelmed by lava flows from the mountain, was buried, and in course of time was petrified. They lie in two tiers, in an area a mile long and a quarter of a mile wide. The largest are 12

feet in diameter and 100 feet long. Volcanic ashes and sandstone that originally covered most of them have been eroded away by the action of the elements while others have been excavated since their discovery in 1871. The petrified forest is easily reached by automobile from Calistoga or Santa Rosa, California. It lies in a region of natural beauty only a few miles from Jack London's "Valley of the Moon" and from where R. L. Stevenson spent his honeymoon.

**A REDWOOD IN STONE**

Erosion through the centuries partially uncovered this giant tree and the work of excavation of its full length has been done by man. It was originally covered with many tons of volcanic ash and sandstone

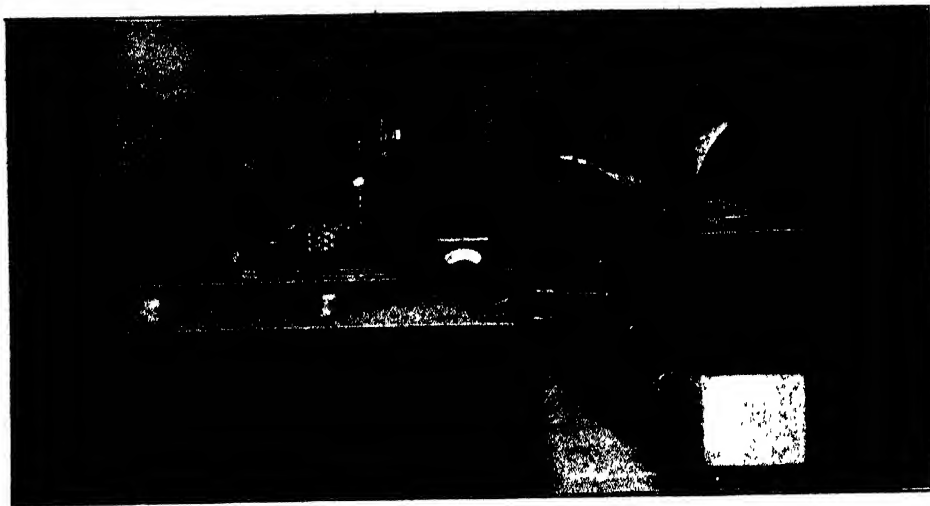
◀ DEEP EXCAVATIONS

Two smaller trees which retain their pristine form and structure to a remarkable degree being exposed to view by slow and careful removal of the overlying earth

TUNNELING WAS NECESSARY▶

In some cases the petrified trees were still covered by hills that had not eroded, and only a part of them protruded. In order to uncover these, it was necessary to dig tunnels through stone, back into the hills





A SPECTROGRAM BEING TAKEN IN THE LABORATORY

Figure 1: Compare the photograph with the diagram below, at right. In the set-up shown above, the photographic plate may be seen projecting above the case at an angle in the rear

Spectrographic Analysis

To a Growing Extent Industries and Laboratories Are Making Use of This Method of Determination, Simple and Far More Sensitive than Chemical Analysis

BY EARLE E. SCHUMACHER

Member of the Technical Staff, Bell Telephone Laboratories

CHEMICAL analyses both qualitative and quantitative are required daily in almost any laboratory. Some standard methods of analysis are slow, difficult, and costly, particularly when they are applied to the determination of small amounts of impurities. A shorter method is available, however, as it has been satisfactorily demonstrated in recent years that many of the more difficult analyses can be quite easily made spectrographically.

When an electric spark passes between two electrodes the intense heat developed vaporizes a small amount of the electrode material. The high potential on the electrodes ionizes this vapor and makes it radiate light of a definite group of wavelengths which are characteristic of the material. On the individuality of the radiation from each element, spectrographic analysis is based.

The electrical circuit producing the spark is shown in Figure 2. The es-

sentia element is a transformer which steps up the regular 60-cycle alternating current from 110 volts to 11,000 volts. This high voltage is sufficient to produce a spark of satisfactory length.

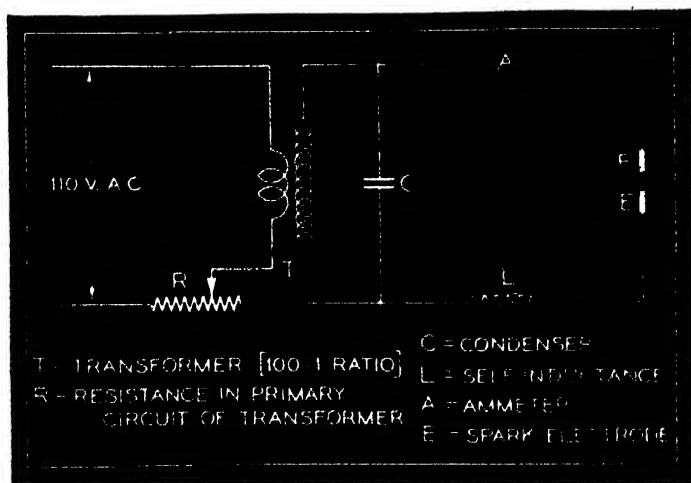
Substances to be identified are ionized in the electric spark and their light is passed through an optical system, consisting of lenses, a slit, and a prism, and finally photographed (Figure 3). In passing through the prism the light waves are bent through angles dependent upon their individual wavelengths and are recorded on a sensitized plate as a series of bright lines. The relative position of each line corresponds to the wavelength of the ray producing it and thus each element produces a spectrogram showing a definite and individual set of lines.

DISTANCES between spectral lines are measured with a comparator, a precise instrument that enables the position of all the sensitive lines shown in a spectrogram to be compared to those of any known element merely by making the required micrometer settings.

Since the most sensitive spectral lines for the majority of the elements are located in the ultra-violet region, the optical system is made of quartz which is transparent to these radiations, instead of glass which is opaque to them. The electrodes are generally made of the sample to be analyzed but, when this is not possible, graphite electrodes impregnated with the unknown material are used.

The spark spectra not only contain the characteristic wavelengths of the electrode material, but they also contain those of the surrounding atmosphere. These lines, due to ionized nitrogen, oxygen, and so on in the spark, do not cause any trouble in the identification of unknowns because they are the same in all spectrograms.

If the presence or absence of any element in a test sample is to be



ELECTRICAL CIRCUIT FOR SPARK SPECTRA

Figure 2: The transformer furnishes alternating current at 11,000 volts, giving a suitable spark. The intensity of the spark can be varied

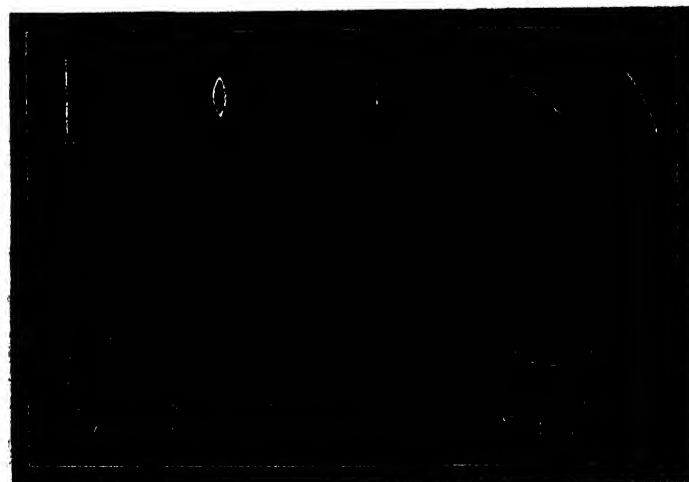


DIAGRAM OF HILGER QUARTZ SPECTROGRAPH

Figure 3: The refracting elements of the optical train are made of quartz because glass cuts off much of the desired ultra-violet spectrum

SPECTROGRAMS ILLUSTRATING ACTUAL CASES OF SPECTROGRAPHIC ANALYSIS

Figure 4, top: The spectrum of the unknown alloy, suspected of containing copper and gold, was juxtaposed to the spectra of copper (top band) and gold (bottom band). Both copper and gold lines extended into the spectrum of the unknown. Bottom: a similar example

determined, spectrograms of the sample and of the element sought are photographed side by side. After the plate has been developed the results are obvious. If the spectral lines of the known element continue through the spectrogram of the sample, the presence of that element is established.

Figure 4, at top, shows the application of this scheme to an unknown alloy which was thought to be composed of copper and gold. The spectra of copper, gold, and the unknown were taken in juxtaposition, with the spectrum of the unknown placed between the other two. It can be readily seen that the lines of the copper and gold spectra also appear in the spectrum of the unknown, which proves conclusively the presence of these two elements.

AMONG the practical qualitative applications of spectrographic analysis is the identification of the elements in a material when only a small amount is available. All large concerns are continually receiving small samples of materials bearing odd names such as "dreamium," "dubium," or "miraculum." These materials are supposed to have certain remarkable properties upon which the inventor has high hopes of capitalizing. Without undue exertion or expense a spectrogram will usually tell quickly whether the material is something new or simply an "old model" newly labeled.

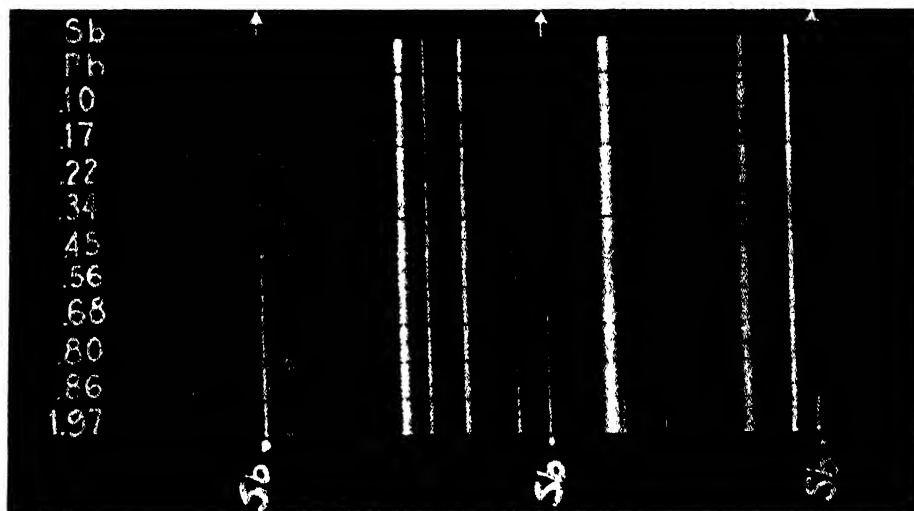
Another application is the identification of the elements in a valuable specimen without destroying it. The specimen itself is used as an electrode and the momentary spark necessary to make the spectrogram does not vaporize an appreciable part. Where alloys of different composition but similar appearance are handled in the same stock room the supplies oc-

asionally become mixed. Spectrographic analysis is particularly applicable in such a situation as it offers a rapid and simple method of identification. For example, some chemically pure platinum became mixed with slightly impure platinum. Figure 4, at bottom, shows spectrograms of both samples, spectral lines of gold, copper, and magnesium being plainly visible in one of them.

the element's whole spectrum is visible.

Generally, impurities ranging from .003 percent to 1.0 percent of the whole can be determined quantitatively by this method. The procedure is to photograph the unknown on the same plate with a graded series of knowns. With a microphotometer to measure the relative brightness of the lines, the unknown can be easily placed.

Figure 6 shows the spectra of a



HOW SPECTROGRAPHIC ANALYSIS HAS BECOME QUANTITATIVE

Figure 5: First study Figure 6, below. Figure 5 is a section of Figure 6, enlarged. Here the decreasing strength of the antimony lines may better be studied. Percentages are indicated at left

Quantitative analysis is also possible with the spectrograph because up to a given percentage, different for each element, the intensities of the characteristic lines of an element are proportional to the relative amount of it in the substances. If one element occurs in another as a slight impurity only, none but the most sensitive characteristic lines of the impurity will appear in the spectrum. As the amount of the impurity increases, these lines become more intense, and new, less sensitive lines appear until

graded series of lead-antimony alloys containing from 0.0 to 1.97 percent antimony. As the antimony content increases, the antimony lines are seen to become more intense. Any unknown quantity of antimony in lead varying from 0.0 to 1.97 percent can readily be determined by comparing the spectrogram of the unknown with those of the graded series.

Spectrographic analysis is extraordinarily sensitive; authorities state that quantities as small as one 3,000,000th of a milligram of sodium, one 100,000th of a milligram of lithium, or six 100,000ths of a milligram of strontium or calcium can be easily detected. Practical quantitative applications of the spectrograph include the determinations of small quantities of almost all the elements. It is an interesting fact that the spectrographic method becomes more precise as the proportion of test element decreases, while the wet analytical method becomes less.

SPECTROGRAM OF A GRADED, QUANTITATIVE SERIES

Figure 6: All the lines marked Sb are those of antimony. Note how they become weaker as smaller percentages are involved. An enlargement of a portion of this spectrogram appears in Figure 5



SETTLING THE EARTH-FILL LAFAYETTE DAM

Soil, brought from borrow pits, is dumped on the dam, wetted, and rolled. Wetting is done by hose direct or by sprinkler truck. Note over-head pipes for supplying water to trucks and hose

plished with a 15-ton steam roller, and petrolithic tampers drawn by a tractor. This tamping equipment consists of a shell roller filled with water to give the proper weight and faced with ball-shaped feet. A sprinkler system for supplying water to settle the embankment consists of three lines of two-inch pipe suspended overhead longitudinally with the axis of the dam.

This dam is a part of the 39,000,000 dollar Mokelumne River water supply project for Oakland and other cities, in the construction of which many interesting types of machinery were developed.

A SECTION of the trench for the water pipe was dug by a trenching machine specially built for the project, said to be the largest trencher ever built, capable of excavating a trench seven feet wide and 16 feet deep. On one occasion this trencher cut, in four days, 4640 lineal feet in stiff clay and adobe. On one section much of the excavation was in hardpan; nevertheless the trencher cut right through it, the trench literally "smoking" at times from the grinding of the teeth through the hardpan. Progress made was about 300 lineal feet of trench 9 to 10 feet deep during each shift. Instead of changing the cutting-teeth on the buckets, the operators between shifts "sharpened" the teeth by welding on Stoodite.

The bell holes for the pipe were excavated with a traveling crane equipped with a clamshell bucket specially built for this purpose. This bucket has a bite-width of 10 to 11 feet, can

Some Unique Methods of Dam Construction

Building of Dams On the Gigantic Mokelumne Project Requires Much Ingenuity

By CHARLES W. GEIGER

THE Lafayette dam now under construction near Oakland, California, will be, when completed, the largest rolled earth-fill dam in the world. It will contain 2,000,000 cubic yards of soil, and will be 170 feet high (maximum), and 1855 feet long on the crest.

This reservoir, of 11,900 acre-feet capacity and covering an area of 915 acres, is to provide equalization, emergency storage, and a by-pass into upper San Leandro Reservoir, on the Mokelumne River water supply project.

THE Lafayette dam will change the topography of the country where it is erected. It will completely fill the space between two hills about one and one half miles west of Lafayette. This great structure will be 850 feet thick at the base, narrowing to a 20-foot roadway at the top. The upper face will be concreted to prevent erosion by the wash of water and the lower face and top will be thickly planted with Bermuda grass to prevent movement of the earth by the rain water.

The area under the dam was stripped to a depth of one foot with an

elevating grader drawn by a tractor. Then the numerous six-inch and eight-inch tile drain lines under the lower half of the dam were laid. The cut-off trench was then excavated with an electric shovel and an electric dragline. Fifteen thousand lineal feet of interlocking steel piling were then driven. On top of this was poured the concrete cut-off wall, which extends eight feet below and eight feet into the clay puddle core.

Some of the embankment material was secured from the reservoir floor, but the major portion is being excavated from a borrow pit about half a mile from the dam, hauled by motor trucks and dumped at the proper point in the embankment. A tractor operating a hydraulic bulldozer is used in spreading the material. The material is then spread evenly by means of a tractor drawing a leaning wheel grader. Compacting of the fill is accom-



BULL-DOZING

A tractor operating a bull-doser (a push scraper) which spreads the soil into depressions after it has been dumped

straddle a seven-foot ditch and excavate both sides of a bell hole at once.

One part of the project was built by the Atkinson Construction Company, whose camp is one of the finest ever installed, representing an investment with equipment included, of nearly 1,250,000 dollars. This part of the project, known as the Pardee dam, is a gravity type, curved dam and will require about three years to build.

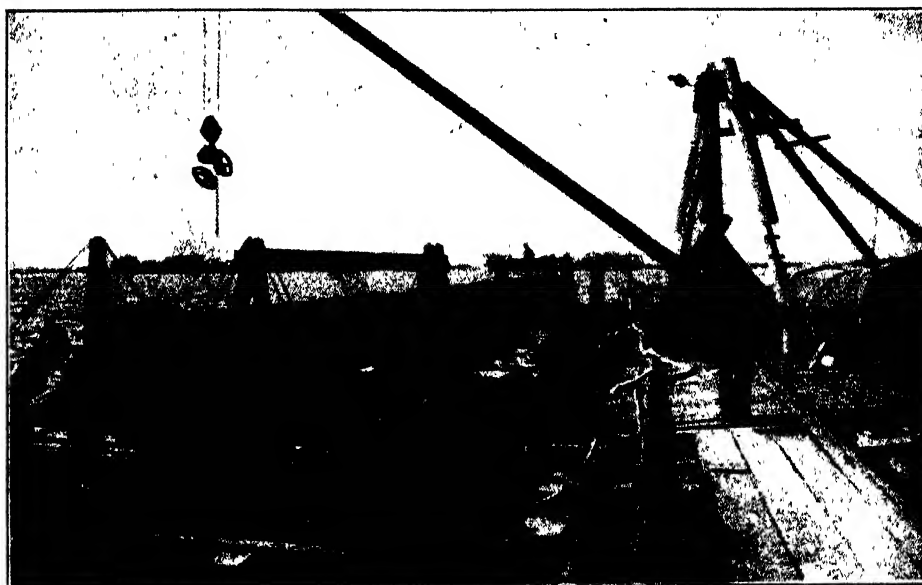
The concrete mixing plant and material bunkers at the Pardee dam site constitute, combined, one of the largest plants if not the largest, ever erected for dam construction.

THE gravel screening and washing plant is unusually large and carefully designed, and cost alone about 250,000 dollars. The concrete aggregates are secured from the tailings dumps left by gold dredges which operated a few years ago in the bed of the Mokelumne River where it emerges from the canyon proper, about six miles down stream from the dam site.

From the bunkers, screened and washed gravel, sand, and rock are carried by an aerial tramway, more than four miles long, across the mountains. This tramway extends from the gravel plant, over many ridges and canyons to a summit in the center of a big bend in the river, and then across the river on a long angle, to the bunkers at the concrete mixing plant. The installed cost of this tramway was about 250,000 dollars.

A flume with a capacity of over 12,000 second-feet, one of the largest, if not the largest, ever built, was constructed by the contractor to take care of the flood water in order that the pouring of concrete could proceed during the winter and so avoid having the expensive equipment lie idle.

Three crossings of the San Joaquin River made by the pipe line were very interesting. The pipe for the river crossings was delivered in 30-foot lengths on barges, and stored on pipe racks sufficiently large to hold a com-



PIPE SECTION FOR THE RIVER CROSSING

Section of 54-inch pipe, to be used in crossing the San Joaquin River, on a barge just after receiving a 24-hour test under high pressure. It is now ready to receive its coating of "gunite"

plete river crossing of approximately 1200 lineal feet of 54-inch pipe. It was then placed in cradles on barges and assembled into sections 150 feet in length. Generally, two sections were assembled on each barge. At the ends of each section a cast steel flange was bolted, the sections were filled with water, and a 24-hour test under 250 pounds pressure was made. At the conclusion of the test the pipes were given a covering of "gunite" four inches thick, reinforced with two layers of wire mesh and $\frac{5}{8}$ -inch bars.

AFTER the "gunite" had cured, the water pressure was released from the sections, the test heads were removed and temporary steel plate heads and rubber gaskets were bolted to the flanges, in their stead. These were to act as water-tight bulkheads.

Removal of the sections from the barges was accomplished by submerging the barge until the pipe became buoyant and then towing the sections from over the barge. This method allowed the long sections to enter the

water uniformly and slowly, thus eliminating any danger of undue stress such as might be caused by launching the pipe from skidways.

The submerging barges were ballasted with sacks of sand sufficient to overcome buoyancy. Also, water-tight bulkheads were installed, making six separate compartments, each fitted with flood gates and relief valves to provide for balancing the barge during its submersion and raising.

The pipe-laying equipment consisted of two 120-foot barges connected by means of trusses, one at each end. Large multiple blocks were suspended from the trusses and carried steel cradles into which the pipe sections were secured for lowering. After the sections had been floated into the steel cradles, the floating heads and rubber gaskets were removed, and the entire load was then controlled by steam donkey engines which were a part of the barge equipment. A lead gasket was placed between the steel flanges and the connecting bolts were then put in place by divers.



COMPACTING WITH PETROLITHIC TAMPERS

These rollers, filled with water to give weight and covered with projecting ball-tipped spikes, were drawn over the loose soil by tractors



RAIN AND MUD CAUSED NO DELAY

Huge six-ton sections of 54-inch pipe were hauled by tractors. When completed, the pipe line will carry water to several California cities



A COAST DEFENSE MONSTER SPEAKS

Navy type, 16-inch gun on barbette carriage for coast defense. This gun hurls a projectile weighing 2100 pounds, its maximum range being about 30 miles with a charge of 702 pounds of powder. Its rate of fire is one round per minute. The mount has been adopted as standard

Our Latest Peace Insurance

With World War Experience As a Guide, Ordnance Experts Prepare, Not For, But Against Another War

By F. D. McHUGH

AT the recent demonstration of ordnance matériel at Aberdeen Proving Ground, Maryland, Colonel James L. Walsh, Chairman of the Defense Division of the American Society of Mechanical Engineers, told of the following incident:

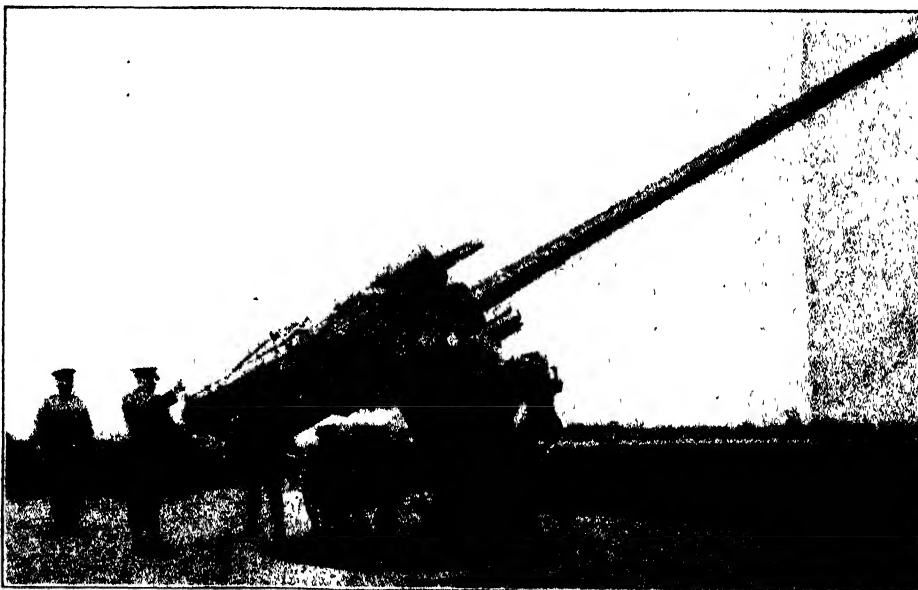
"During the World War, a contractor having more patriotic zeal than knowledge of the situation, insisted that he be awarded a very large contract for fire-control matériel." Fire-control matériel, as anyone acquainted with army matters knows, consists of a variety of complex range-finding and altitude-finding equipment. "This manufacturer claimed that his plants had had much experience in the manufacture of this equipment and he was sure he could handle a sizeable job in its production. It developed that he was, as a matter of fact, a very large and successful manufacturer of fire-extinguishers—those little blue bottles we used to see hanging on the wall marked 'For use in case of fire.'"

IF large manufacturers were as ignorant of the necessities of war, during war time, as indicated by this story, one can hardly imagine the extent of the layman's ignorance. But the World War caught us unprepared and, despite the great amount of publicity

given to war matters and the tremendous organizations built up to produce war materials, the country was slow to learn because it had to start from the beginning.

Today, without the necessity of our maintaining huge supplies of expensive equipment, the situation would be

different should war in protection of our sovereignty be necessary. We have been taught preparedness, and have prepared—by the education of industry: industry has been shown just what would be expected of it in case of war. The country has been divided into 14 industrial districts to



105 MILLIMETER GUN FOR SEACOAST OR FIXED DEFENSES

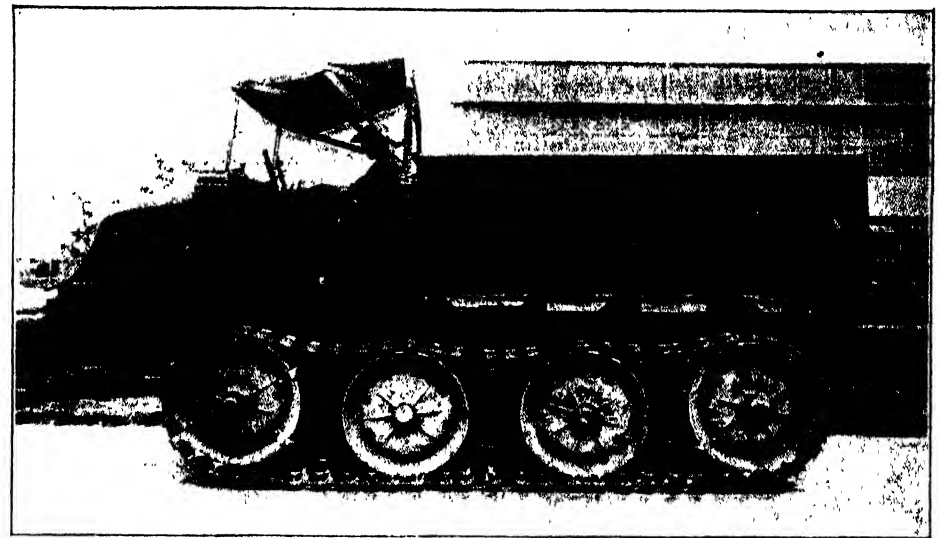
Loaded by a pneumatic rammer, this gun can fire about 15 shots per minute. It fires either 33-pound shells or shrapnel at a vertical range of 12,000 yards and a horizontal range of 10,000 yards

each of which has been allocated a quota of the articles it can manufacture. Also, powerful national societies have organized to foster a spirit of preparedness. One of these is the American Society of Mechanical Engineers which has a National Defense Division; another is the Army Ordnance Association, numbering many thousand civilian members—engineers and manufacturers—which was organized to co-operate with the government and “keep alive an interest in and a knowledge of the design, production, and maintenance of munitions.”

With the co-operation of these, the Ordnance Department has worked constantly to improve, develop, and perfect ordnance matériel, and as a result, our present matériel represents a tremendous advance over anything possessed during the war and is the equal of that of any other nation today. But the solution of the problem has not yet been attained.

FOR example, time and money must be saved “from the blueprint to the finished product.” The solution of this may resolve itself into the giving of “educational orders” to manufacturers, not on a competitive price basis, but for the knowledge it will give them of how to adapt their plants to the production of particular pieces.

The recent demonstration at Aberdeen Proving Ground was an educational event of great importance. Association members, engineers, and manufacturers were shown ordnance matériel in a spectacular display, and thus were given a comprehensive idea of the ordnance problem. A huge 16-inch gun on a barbette carriage and permanent emplacement, a 12-inch gun on a railway carriage, and numerous smaller guns were fired. Day and night firing of anti-aircraft guns,



A CAISSON TRACTOR-TRUCK

Guns are useless without adequate supplies of shells. This photograph shows a three-ton tractor caisson developed by the Ordnance Department for speed on the road or in soft ground

the effectiveness of air bombs, motorized artillery of many unique types, and tanks in action were demonstrated.

One of the most remarkable developments in ordnance matériel shown is the electrically-operated automatic range-finder and fire-control apparatus which may be used on the three-inch gun or on machine guns. The turn of a wheel or two sets in action the delicate mechanism that picks up the sound waves from an airplane, actuates the controls that determine the altitude and distance of the airplane, and aims the multiple-mount of guns. Fog or clouds could not screen an airplane from the effective fire of guns controlled by this mechanism, the details of which are being kept secret.

The Browning automatic 37-millimeter anti-aircraft gun is another great achievement. It fires 60 shells per minute, each weighing one and one quarter pounds, with the enormous

muzzle velocity of 2800 feet per second.

One other very recent development, the new mount for the three-inch anti-aircraft gun, should be mentioned here since it is a radical departure from the wheeled types hitherto tried and discarded. The new mount consists of four long steel beams that lie flat on the ground, spreading out from the gun platform. It can be prepared for action in about 10 minutes and as quickly restored to marching order.

The gun used on this mount is the recently adopted standard three-inch piece which throws a 15-pound shell to a height of 12,000 yards and 19,000 yards horizontally. Its rate of fire is up to 30 rounds per minute. In this gun, the barrel liner, when worn from constant firing, can be removed and replaced by a new liner, under field conditions, in about 30 minutes, thus obviating slow and costly trips to the arsenal for relining.



Harber

THE MACHINE GUN'S BIG BROTHER

One of the newest pieces of ordnance, the Browning 37-millimeter automatic gun. Shells are fed into the gun in clips of five as shown



MACHINE GUNS IN ACTION

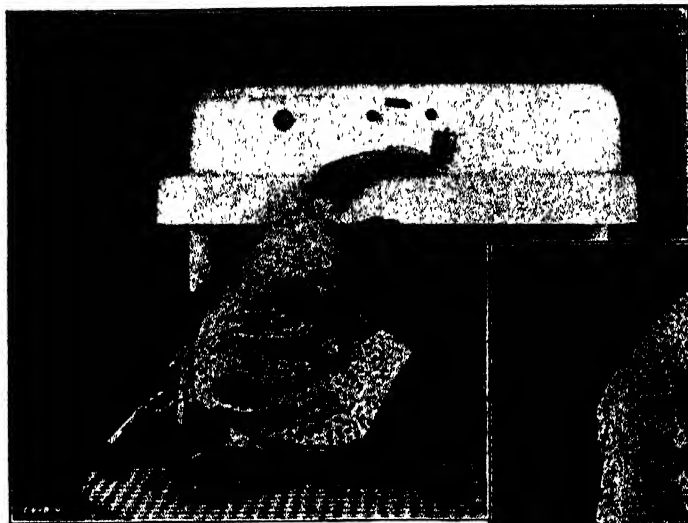
The airplane target of this group of guns is located and the guns are aimed and fired by the automatic electrical range-finding equipment

Household Inventions



NON-SLIP HANGER

A push on the triggers of this device causes the upper arms to fly up. When a button is pushed, the padded arms spring down on the garment.—*Kno-Fall Garment Hangers, Inc., 720 Madison Ave., New York*



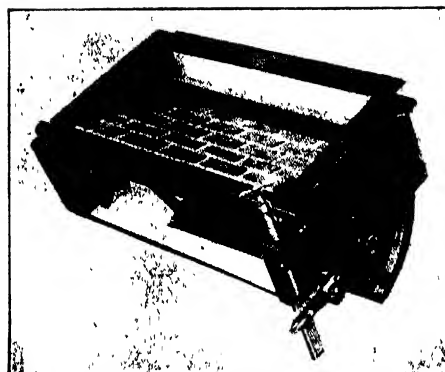
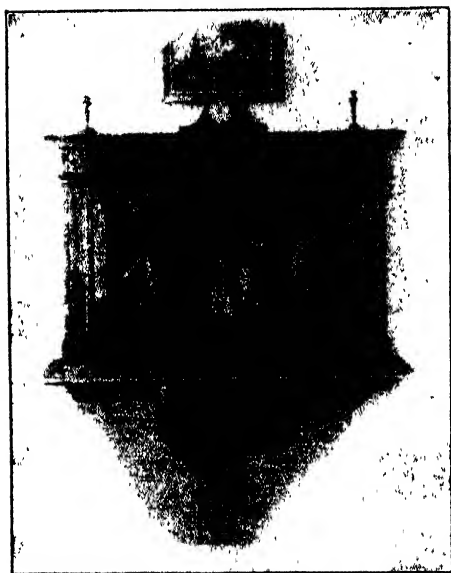
INSECT CONTROLLER

Getting into the crevices where insects breed and multiply may now be done efficiently with the equipment shown above and to the right. The special container full of insecticide is attached to the handle of a vacuum cleaner and the blower attachment then thoroughly spreads the insecticide.—*Airway Electric Appliance Corp., Toledo, Ohio*



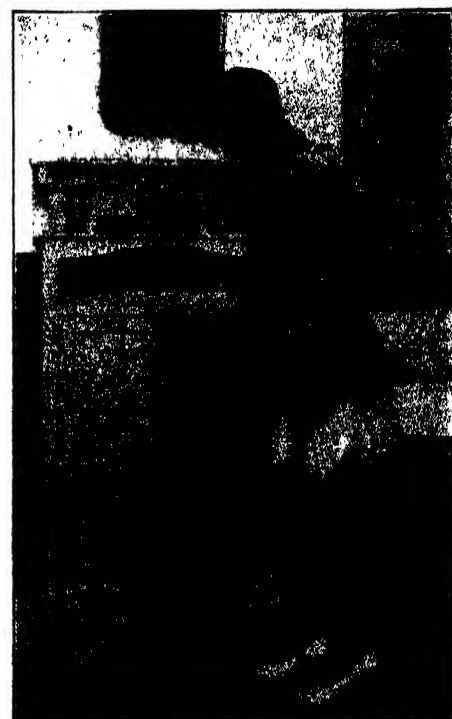
SERVING SCOOP

Like the "cut-out" scoops used for ice cream at soda fountains, this new one of aluminum is sold in five and ten cent stores. It is useful for serving ice cream, rice, or mashed potatoes.—*Lorraine Metal Mfg. Co., New York*



◀ A DUSTLESS FIREPLACE

Despite the very modern heating equipment of today, the open fireplace is still in vogue. Thus there remains the problem of ash removal. The illustration at the left shows a skeletonized fireplace which has a special ash trap and chute to the basement. Above is shown the trap. Instead of shoveling the ashes into a can and carrying them out, all that is necessary when this device is installed is to give the lever a pull and the ashes fall into the basement.—*Fireplace Devices Co., 136 W. 83rd St., New York*



BATHROOM DRESSER

A handy cabinet that takes only a few inches of floor space and offers a dresser top for toilet articles, an open shelf for towels, storage shelves for soaps, sponges, brushes, et cetera, and a ventilated compartment for soiled linen. It is made in several sizes to be set into or against the wall.—*El Paso Sash and Door Co., El Paso, Texas*

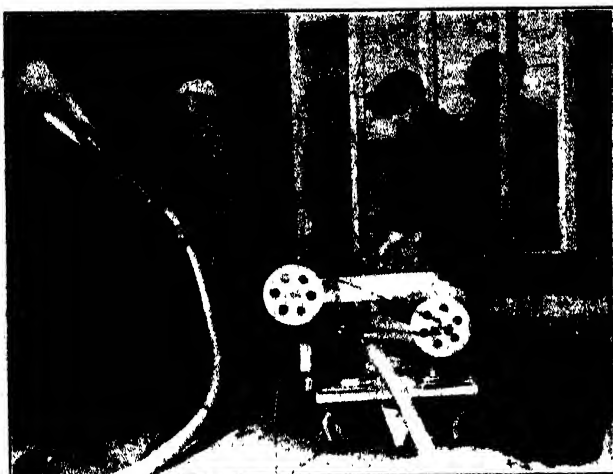


◀ ELECTRIC IRON CABINET

To be installed in the wall next to the folding ironing board or other convenient place, this cabinet prevents electric iron fires. The hot iron may be safely closed in the steel and asbestos cabinet.—*The Cunningham Mfg. Co., Los Angeles, California*

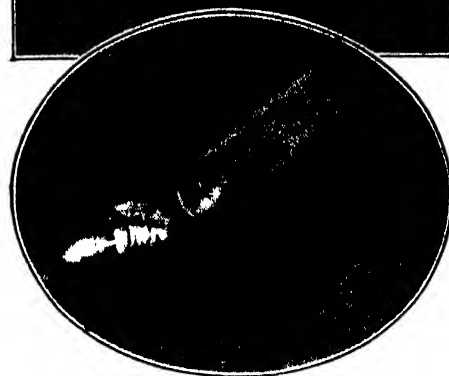
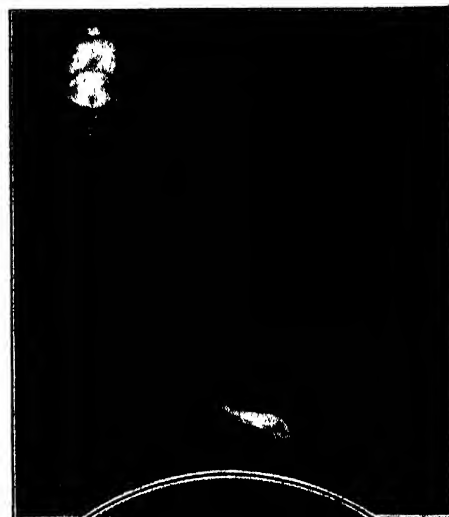
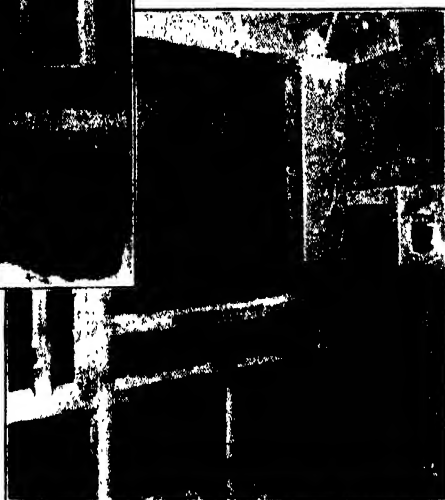
Inventions

New and Interesting



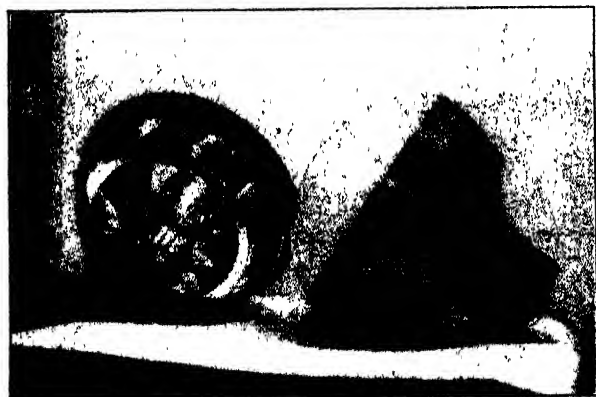
FIBROUS WALL INSULATION

A new form of insulation against heat and cold for buildings. It is sprayed on the inside surface of sheathing between wall studs by means of compressed air. It is made of pulverized newspapers and magazines to which a fireproofing chemical is added during the shredding process. The binder for holding it in place after spraying is silicate of soda (water glass). It can be applied to practically any kind of building surface in thicknesses of one half an inch up to the full depth of the studding. This material closes openings around pipes, electrical conduits—in fact, goes into all openings in the walls, and insulates against sound and temperature changes.—*Sprayo-Flake Co., 56 South Bay St., Milwaukee, Wisconsin*



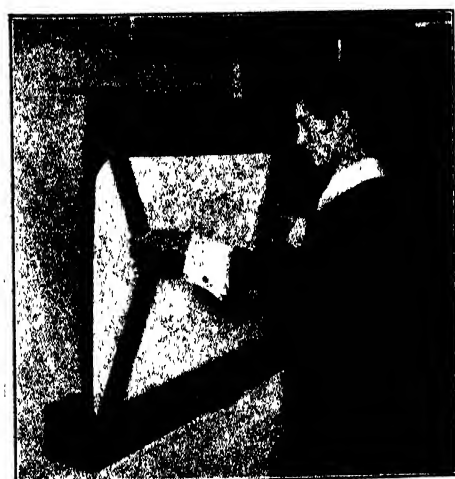
FLASHLIGHT

Somewhat similar in appearance to the pocket cigar lighter, this flashlight is compact, and easily carried in pocket or purse. It lights automatically when the top is opened. Closing the snapper top cuts off the light. Parts have been reduced to a minimum; it has no case or switch.—*Burgess Battery Co., Harris Trust Bldg., Chicago*



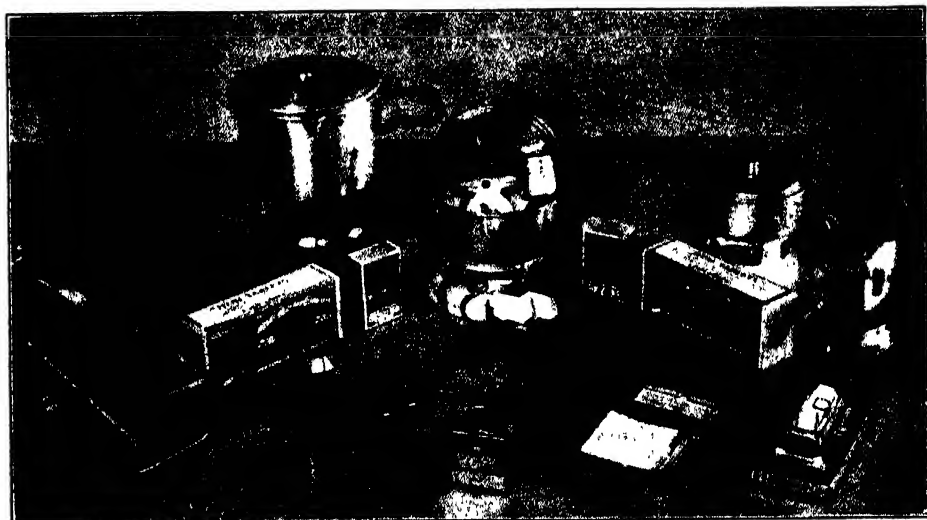
DAYLIGHT LAMP

A lamp which, according to the results of tests, emits light having a color temperature the same as that of the sun. It utilizes a gas-filled, blue-glass bulb. This bulb is surrounded by a large number of mirrors tinted in different colors and placed in definite combinations to correct the spectral composition of the light without absorption.—*Sunlike Illuminating Co., Inc., 21 W. 19th St., New York*



SELF SUPPORTING SCREEN

An ingenious screen for showing amateur motion pictures in the home. No nails or finding of wall space is necessary as it will stand on any table, the carrying case being heavy enough to act as a base. Uprights are hinged for folding.—*The De Vry Corp., Chicago*



HEAT TABLET AND SPECIAL UTENSILS FOR USING IT

In the lower right hand corner may be seen a box of heat tablets which look like elongated sugar tablets. They are a new importation from Switzerland. The tablets burn with a hot, blue flame like that of alcohol, but will not melt or evaporate. They are light weight, practically odorless, and non-explosive; and may be used safely anywhere.—*Irving Puttmann, 420 Lexington Ave., New York*

Inventors Turn to Toys



◀ LOCOMOTIVE

This locomotive is made for the boy who likes to build his own, for it comes "knocked down" packed in a box. It is assembled or taken apart by following instructions; and parts may be replaced. -- *Dorfan Co., Newark, New Jersey*



CLIMBING TRACTOR

Over castles and forts of building blocks, over sand piles, books, or hurdles, or up an incline of 55 degrees, this powerful toy goes without faltering. It will pull small trailers with heavy loads or stand on its nose and travel along—*Animate Toy Co., Inc., 200 Fifth Ave., New York*



▲ CHAUTAUQUA DESK

A folding desk equipped with green chalkboard, educational scrolls in a large variety of subjects according to the age of the child, chalk, et cetera, that will give the child's imagination full play. It develops art talent.—*Lewis E. Myers and Company, Valparaiso, Indiana*

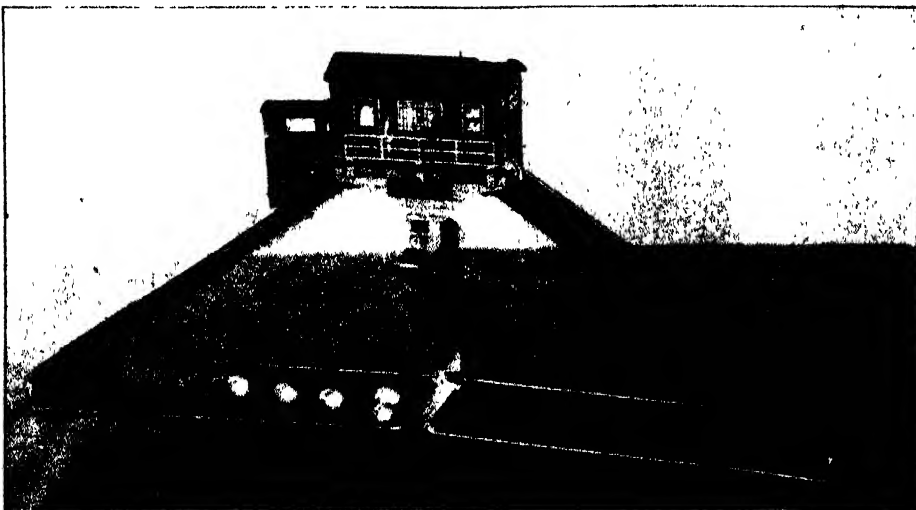
▼ CABLE CAR

The cars of this toy ascend and descend alternately if balls are kept in the hopper at the top.—*R. H. Macy Co., Broadway at 34th St., New York*



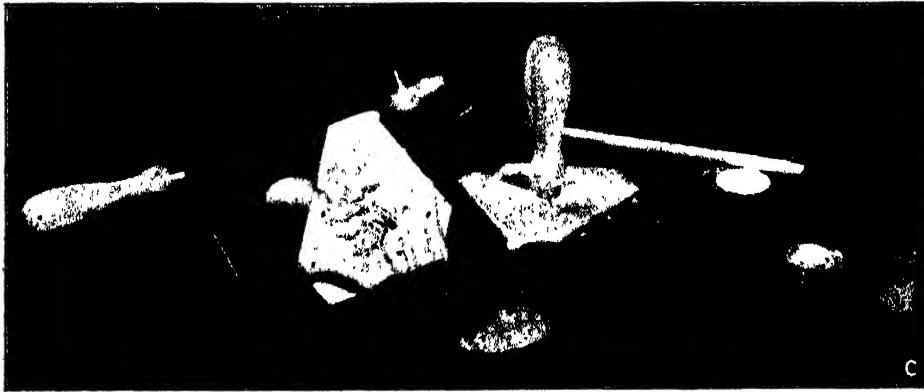
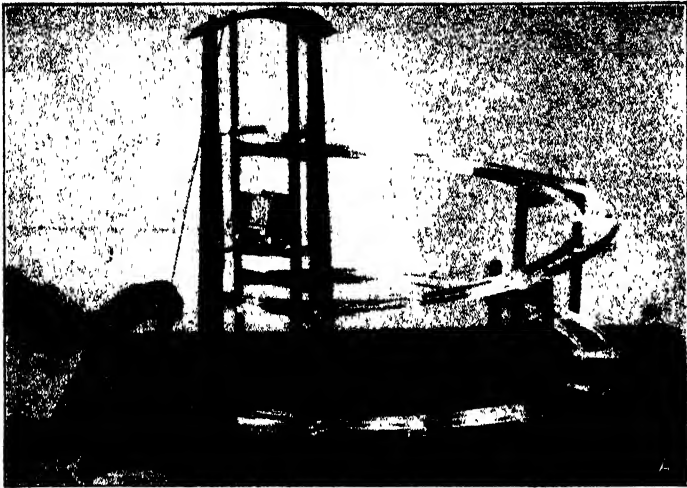
▲ INDOOR GOLF GAME

Putting, approaching, digging out, all are the same in this game as in one on the links. The force of a stroke, as shown by an indicator, is recorded on the "course," which is a separate board, by moving forward a marker. The struck ball is recalled by a spring.—*Play-golf, Inc., 641 Union Trust Bldg., Cleveland, Ohio*



▲ GALLOPING HOBBY HORSES

Moving legs on this horse are so arranged that the natural rocking motion of the child causes it to go forward at a gallop. This toy is made of heavy plywood with metal bolts and reinforcing plates, but it is light enough for the child to carry around. Finished in lacquer.—*The Go-pony Co., Rockford, Illinois*

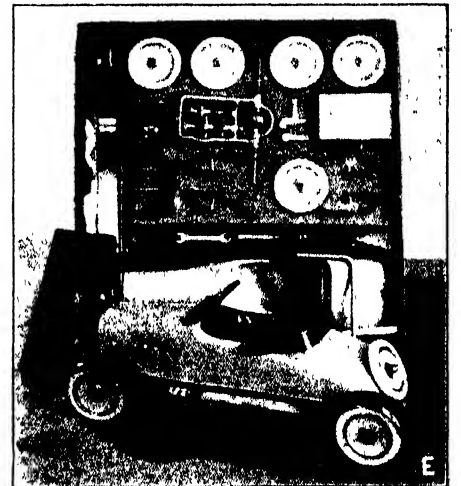


exercise his or her wits to the fullest. The child receives it in "knocked-down" condition, packed neatly in a box. A little work according to instructions, with the screw-driver and wrench that are supplied, and *presto*, there stands the complete automobile. It can then be taken

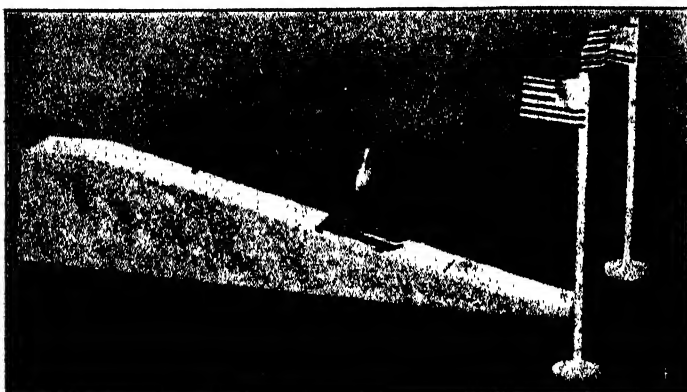
ON this page is illustrated a group of toys that will delight the child who has a mechanical turn of mind. The photograph lettered *A* shows a spiral track upon which a toy railroad gondola runs. When the car reaches the bottom, it is caught by an elevator which is then lifted by means of a cord to the top position where the car may again start its speedy trip to the bottom. Photograph *B* is a swimming pool which includes a dressing room for the doll swimmers, diving platform, and a shower. The shower is a miniature pump, operated by a lever, which lifts the water from the main basin up to the shower head. *C* shows a set of lead-molding tools with which lead soldiers, knights, or other figures may be cast. The set consists of a ladle for melting lead over a flame, molds, tongs for handling the hot figures, lead, and paint for decorating the figures after they have cooled. Although the cow shown in *D* is only a toy, she can be made to give milk and the child who plays with this toy will get a great deal of amusement out of milking her.



The secret of this lies in the tank within her body into which milk—or chalk and water—may be poured through the opening in her back. The automobile shown in *E* gives the ingenious child a chance to



apart and assembled as many times as the owner may wish. A ski-jumper that really jumps is shown in photograph *F*. When the figure, which is mounted on skis with wheels, is placed at the top of the incline, it races down, hits the trigger near the bottom, and is vaulted by the mechanism over the bar between the two flag-poles. Sometimes he doesn't quite make it and his skis catch on the rod. This serves simply to make him turn a somersault and then go over the rod. *G* shows a new airplane kite which, when flying, looks just like a distant plane.—*F. A. O. Schwarz, 303 Fifth Ave., New York*

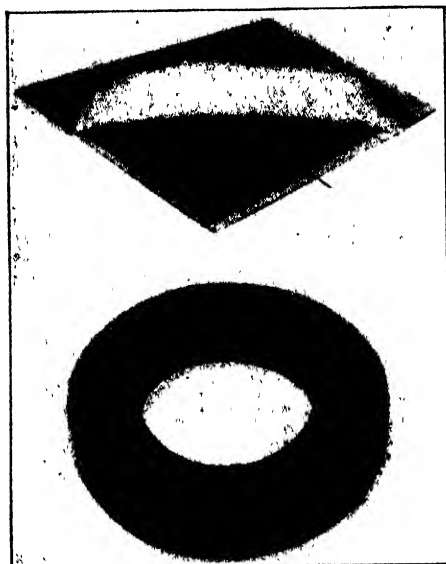


The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

Evolution of a Tanning By-product

CONSPICUOUS among manufacturing successes are those industries which have properly appreciated the commercial value of their by-products. The story of the packers would, indeed, be different reading if meat were the only article ever offered for sale by that industry. This is no less true of other industries. The



At the top of this illustration is shown a chair seat pad filled with felted animal hair. At bottom is a felt polishing washer

utilization of by-products is one of the so-called "success principles."

It has not always been easy to make a success of by-product utilization. In most cases, years of scientific research and painstaking study have preceded any attempt at merchandising. Experience has justified this preliminary expense and research

and, as a result, scientific laboratories are becoming indispensable in manufacturing.

Remarkable things have been accomplished with hair, the tanner's by-product which was once considered worse than worthless because, so far as was known at the time, it filled no important need and its disposal often boosted factory costs. Practically the reverse is true today.

This one-time waste product has been transformed from an article which manufacturing operations had rendered unmarketable, into a commercial article, displayed in the sales rooms of our best stores, purchased by discriminating women and, in its variety of uses, a home luxury.

In the walls of many homes, cattle hair in the form of a felt building blanket, insulates against cold in winter, heat in summer, and against sound every day of every season.

Rug and carpet cushions made of hair are rapidly becoming nationally known articles. Manufacturers of plushes, carpets, and yarn, are using hair in the fashioning of articles which interior decorators show with pride to customers who demand and pay for the best. Hair and hair felt are important articles in the manufacture of upholstered furniture.

In the latest car models at the automobile shows, in slippers of many shapes and shades, in gymnasium mats, on church benches, on household ironing boards, around ice cream and milk cans—these are a few of the many ways in which this by-product of the tanning processes has been adapted to, and made an important part of, the commercial products of today.

There are no apologies needed for this protective covering which nature has provided for animal life. It insulates the skin from heat and cold and protects the body from bruises and abrasion. It is not supplied with nerves and has great durability. On fish and reptiles, the protective covering takes the form of scales, and on

birds, feathers. In mammals it is the fine thread-like substance of many textures and colors known as hair.

No species of mammals is without hair. It varies from the finest and softest down on a lady's cheek to the coarsest bristles of the hog and the stiff quills of the porcupine.

Hair is the last part of the body to decay, is believed to grow even after death, and is known to last for centuries. In a Chicago bank window display of Indian relics, there is exhibited a woman's scalp taken by some Indian brave more than 100 years ago. The hair shows no effects of age. It is not dissimilar in color and in texture to the shorn tresses of any modern girl. Even when exposed to the elements, hair will not deteriorate and can be dissolved only by heat under pressure or in the presence of alkalies or acids.

The largest use of hair for manufacturing purposes is in the form of felts. Hair felts vary from the thick, loosely felted goods which are used for upholstering and insulating purposes, to the hard felts which are used for glass and stone polishing, slipper soles, washers, and cartridge wads. Hair felt is recognized as the standard insulating material for refrigeration plants and is used on the majority of refrigerator cars in this country. In this service, it provides high-test insulation from heat and cold.

Punched felt is used extensively as pads for laundry flat work ironers. As an upholstering material, hair felt has a wide use in the furniture and automobile trade as well as in car seats.

A higher grade of felt, in which the hair is more carefully carded before felting and the fabric is full after felting, also uses large quantities of hair. In this class of goods are the shoe, sole, cushion, polishing, and cartridge felts. For shot-gun shell wads, the longest and highest priced cattle hair is used, while in the insulating felts, short and medium hair is used.

Coarser goat hairs are used for stuffing



Offices where quietness is conducive to efficiency, use hair felt to deaden sound in typewriters, walls, et cetera



Applying hair felt in sheets to the ceilings and walls of radio broadcasting studios, where quiet is necessary

in the upholstery trade and also in the ready made or hard wall plaster trade. The finer grades of goat hair are used in the spinning trade.

Hair is now successfully blended with wool—which is but a particular form of hair—to produce yarn and cloth which,



Attractively decorated application of hair felt to an office building for the correction of acoustics

in many cases, is considered equal in quality to pure wool, and superior to wool and cotton, or wool and shoddy mixture. In the carpet industry especially there is a large use of spinning hair. Calf hair is used in the manufacture of plush as well as of felt.

Tanners now have a proper appreciation of the real value of this by-product. A definite educational campaign has been carried on with this end in view. As a result of this, the quality of the hair as it comes from the tanneries has steadily improved. More attention has been given

to the proper removal of the hair and to the processing after the hair is removed.

As a result, the product has come to the market with a stronger fiber, with no lime, dirt or other foreign material. As this improvement took place, new uses, which would have been impossible if the raw material had not been subjected to various improvements, were found for goods manufactured from hair, so that now the product has been lifted to a high place of respectability.

End-squaring and Packaging Lumber

CARPENTERS and builders have long recognized that "squaring up" the ends of boards with a hand-saw to make them suitable for use on the job is an economic waste. Since practically every board has to be made "four-square" before it can be used, the operation of sawing off the rough ends as they come from the lumber yard consumes no small part of the carpenter's time which could be devoted to the refinements of his craft were this not necessary.

A solution of this problem which is expected to speed up the carpenter operations on a building job has been worked out by the Weyerhaeuser-affiliated companies whose mills are in Minnesota, Idaho, and the Pacific Northwest. Their development engineers have invented a saw which will cut across the grain of a board, leaving a surface as smooth as if it were planed.

Instead of shipping its lumber with the ends of boards rough, as is usually done, these mills have added one more manufacturing operation to their routine: that of making the ends of each board of the selected lumber four-square, and shipping it in packages held together with a specially designed fiber end-cap.

The re-butting process and machinery and the method of packaging the bulky commodity were evolved after many months of experimentation. The saw is set at exactly 90 degrees to the lumber to be cut. The saw-teeth are so ground on the arbor as to insure each tooth traveling in a

true circle, thereby giving a smooth cut.

A belt conveyor brings the boards to the saw in stacks of three to six, according to the thickness of the wood, and they are gripped by guides operated pneumatically and faced with rubber.

The revolving blade is then swung down, being operated on some machines by an electric push button and on others by a lever. After the saw has passed through the wood another belt carries the boards to the other side of the trim-bench so that the other ends may be cut off.

When both ends have been trimmed, there remains only to affix the end caps, and the package of lumber is ready to be shipped direct to the job.

American Dirigibles to Dwarf "Graf Zeppelin"

WHILE the *Graf Zeppelin*, world's largest airship, dwarfs her sister, the *U. S. S. Los Angeles*, American dirigible designers and enthusiasts are looking forward to 1931 when the all-American *ZRS-4*, a dirigible nearly twice the capacity of the German dirigible, will take the air. A little less than a year later the *ZRS-5*,



Caps of strong fiber, and bearing the species and grade of the lumber, are placed over the ends of lumber that has been square-sawed

a sister ship from the same patterns will be produced here in America by the Goodyear Zeppelin Corporation as the result of a contract signed by the United States Navy just a few days before the *Graf Zeppelin* left Germany.

Even earlier, the *Graf Zeppelin's* world dirigible title will be challenged, for in England two dirigibles, both of 5,000,000 cubic feet capacity, are nearing completion. They are John Bull's bid for supremacy in the air lanes as well as on the sea's surface. America may expect visits from the *R100* and *R101* in the spring, although they may be flight-tested on the air routes to Egypt, India, and Australia, for which they were designed.

Not discounting the achievements of the *Graf Zeppelin's* flight, airship experts note that the new German airship is an enlarged edition of the *ZR-3*, now the *Los Angeles*, which four years ago made the same transatlantic crossing from Friedrichshafen to Lakehurst on its way to join the United States Navy. Twenty-eight ballonets in-



The saw that cuts off the ends of boards exactly at right angles, has teeth pointing straight within the plane of the blade. The ends are left square



Highway surfacing machine for cutting down high spots, irregularities, uneven expansion joints, and repaired patches. It is run by air-cooled gasoline motor and mounted on wheels for quick transportation. The swivel castor in front is raised by lever, thus lowering cutter head to make contact

stead of 24 make the *Graf Zeppelin* 771 feet long instead of 658 feet. The diameter of the *Graf Zeppelin* is only 10 feet greater than that of the *Los Angeles*. Both have five engines and their external appearances are similar. The principal difference in the interior is accommodation for the gas fuel ballonets at the bottom of the large envelope and an extra corridor or "cat walk" running the length of the German ship.

The new navy airships, when completed, will be only 14 feet longer than the *Graf Zeppelin*, but they will be 132.9 feet in diameter and hold 6,500,000 cubic feet of gas compared with the *Graf Zeppelin's* 3,708,000. The American ships will incorporate some new design factors that promise to make them unique.

Due to the use of inert helium instead of explosive hydrogen for inflation, it will be possible to place the eight engines inside the hull. Engine specifications have not been announced, but it is considered probable that gasoline will be abandoned for heavy oil fuel. The internal engines will allow the ship to slip through the air with less resistance and there will be less danger of the engines being torn off in a severe storm. A complete airplane hangar will be housed within the hull from which five airplanes can be launched from a trapeze, like performers at a circus.

The framework of the new dirigible will have a strength unequalled in any other design. Made of duralumin, the favorite dirigible metal because of its lightness, every portion of the frame will be close to corridors and passageways and accessible for inspection and repair even during flight.

—Science Service

Manless Power Station

AN electric distributing station that will ultimately be able to supply power sufficient to light the homes of approximately 300,000 families and will be operated without a human being inside its walls, was placed in service on September 17, at 238th Street and Spuyten Duyvil Road, New York City, by The New York Edison Company.

This manless station, one of the largest in the world to be operated without a

single attendant, will be controlled from another station more than three miles away. The distant operator can close or open any switch, placing in service the various transformers and circuits in the new station, simply by pressing keys which send over wires electric impulses of the dot and dash system used in telegraphy. Also he will receive automatic signals from the station which will inform him whether the equipment is functioning properly.

It will be necessary for human beings to visit the station only once a week to inspect the apparatus. A complete burglar alarm system on windows and doors and other places will protect the building electrically.

This control system was devised by the Westinghouse Electric and Manufacturing

125 by 85 feet in dimensions, and one tall story in height. It is one of the numerous distributing stations of The New York Edison Company system. This station will receive from the generating stations current at 13,200 volts and distribute it at 2300 volts over its feeders which supply the street mains.

A visit to the station would be a somewhat uncanny experience for a layman. He would see machines starting and stopping, switch breakers going on and off, and all without a sign of an operator, as though some mysterious being were in control of the place.

The mysterious being would be the operator in the other station more than three miles away. He would be controlling the station through impulses sent over telephone wires leased from the New York Telephone Company. The pressing of a key only once automatically flashes over the wire a telegraphic code composed of 25 dots and dashes. If anything prevents the switches functioning when the operator presses a key, the impulses continue to go over the wire until the service is performed. Each key has its own arrangement of dots and dashes, or code, which controls a particular piece of apparatus.

The flash of a signal light tells the operator when a switch has operated. He can also press keys to ascertain whether the various feeders are alive and operating properly. Another key will cause meters to record for the operator the load carried by the feeders, and also their voltage. If any of the transformer banks should overheat, a lamp will flash and a bell will ring.

Two Colts Foaled by Old Mare Mule

OLD BECK is only an ancient Texas "cotton mule" mare who has been on this planet long enough to vote, but she has done her bit toward breaking the age-old reproach of sterility leveled at her hybrid race. For she not only has borne offspring—two lusty colts—but now



Portable concrete-surfacing machines, run by compressed air, for use on either green or old concrete. Each machine weighs 13 pounds and can be handled in any position. The rotating cutter wheel is equipped with a flexible joint to insure an even action and to prevent marring of the surface

Company and adapted for The New York Edison Company by the latter company's engineers. The first supervisory control system of the Westinghouse Electric and Manufacturing Company was put in successful operation in 1921.

The new station is a brick structure

has a grandchild. For a mule to have a foal is an almost miraculous rarity, but for one of these to propagate is practically unheard of.

Yet this is the record of Old Beck, as detailed in the forthcoming issue of the *Journal of Heredity* by A. H. Groth of

Texas A. and M. College. Her first offspring was a daughter, sired by a jack, and foaled in 1920. This feat brought her to the attention of the college authorities, and she was soon given a home on the campus. Subsequent matings with other jacks failed to produce another colt, but a noted stallion of the college stud sired a foal that has grown up to look quite like a horse—and a fine horse at that.

Old Beck's mule daughter has remained without issue, in spite of several attempts to breed her, but the horse-like colt, a stallion, has sired one healthy colt, now over a year old.

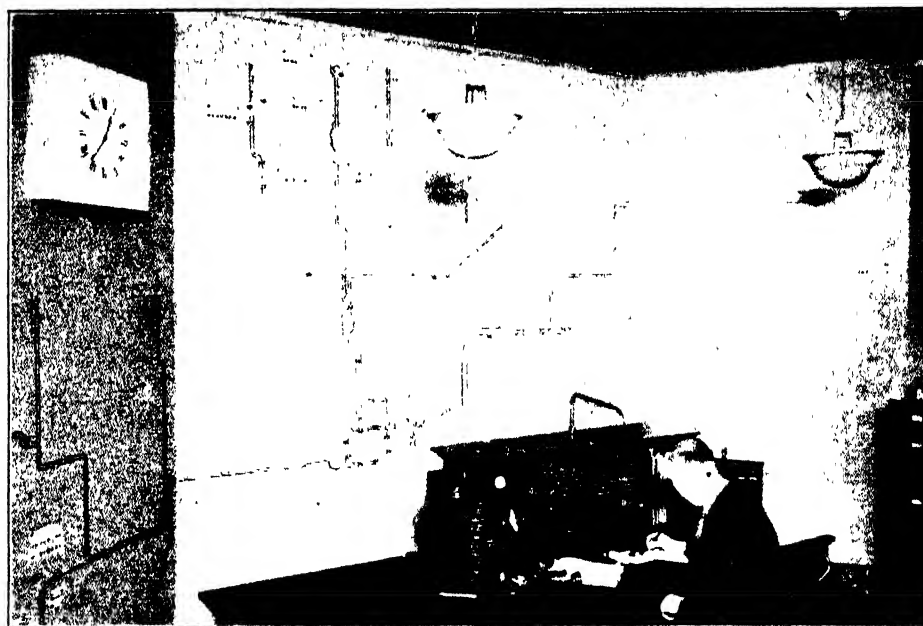
Mr. Groth says of him, "He has developed into a nicely balanced horse of saddle type . . . He performs well under saddle and is possessed of remarkable intelligence. The only mule characteristic which he shows is his dislike for crossing a ditch or stream."

In the same issue of the *Journal of Heredity*, Erasmus Haworth of Lawrence, Kansas, records another case of a mule mare producing a foal sired by a jack. The same mule is now believed to be with foal a second time.—*Science Service*.

Diamonds Used for Cutting Metal

TOOLS pointed with diamonds have been used for years to dress grinding-wheels and to do cutting work in hardened steel and other materials that are too hard to be cut by steel tools. It seems to be a more recent discovery that they can be used economically in machining a number of softer materials, particularly those on which steel tools do not have satisfactory life, says a recent issue of the *S. A. E. Journal*.

Among the materials most commonly considered for machining with diamond tools are hard rubber, vulcanized fiber, ebonite, vulcanite, mica, "felt" paper-rolls, bronze, bearing metal, aluminum, copper,



Indicator board consisting of red and green lights and lines to indicate electric power lines as used in Chicago to check power consumption of railways

under certain conditions. For the automotive industry, it is probable that most of the interest in the application of diamond tools will be centered on their use in turning bronze and other bearing metals, aluminum alloy, copper, and Monel metal, at least for the present.

The tool can be run at such high speed that it is practical to take a very fine cut; this, with a marked freedom from tearing effect, making possible a smoothness of finish that can be obtained with no other known method of machining.

In turning aluminum, copper, and malleable iron, the diamond tool does not tear the metal and leave it rough, as does a steel tool. To make the most of its ability to give a smooth finish, the feed of the tools should be small, and very high speed

often, also, as black diamonds. Because of the absence of cleavage planes, carbons are less liable than borts to fracture and are said by some to be more desirable for the making of diamond bits for core-drilling in rock, the modern method of prospecting.

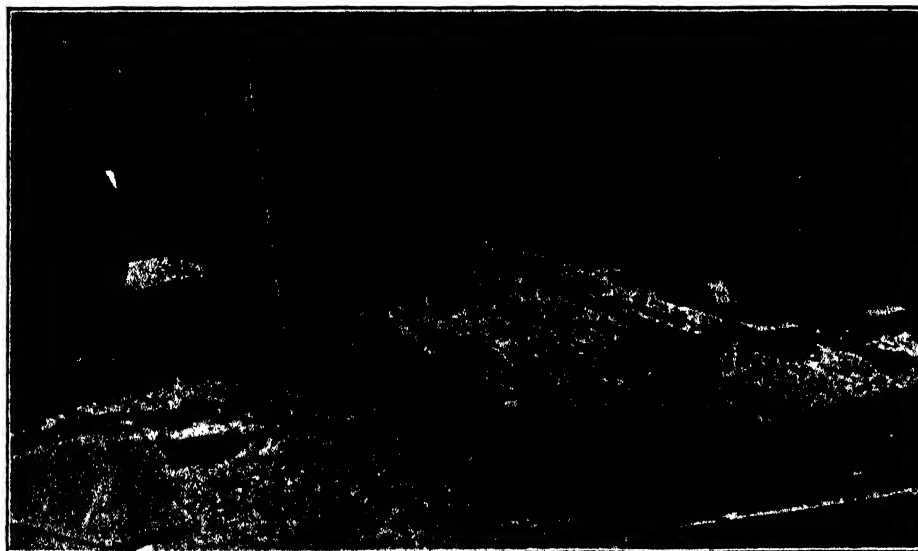
Visual Key to Power Used

THE part that electric railway service plays in the life of a large city is well illustrated by the diagram in a "loop" office building in Chicago. This diagram is dotted with many red and green lights; colored strips show the power lines and blocks represent the 35 sources of power. An inspection of this diagram will reveal the condition of the sources, whether idle or operating, and the sets of tracks that are energized by them.

The office instruments are connected to two automatic sub-stations several miles away. These instruments are so sensitive that at certain times of the day it is possible to determine just what moment a North Shore train from Milwaukee enters the system at Niles Center. From this master office, traffic could be tied up all over the unified system.

Tiny Seed Produces Enormous Tree

THE kernel of the seed of a *Sequoia gigantea* or California Big Tree is less than a quarter of an inch in length and is only as thick as a medium cambric needle. Yet from this infinitesimal germ may grow a tree that, like "General Sherman" in the Sequoia National Park, weighs over 6000 tons.—*Science Service*.



Portable unloader for railroad gondolas. As the material falls from the hopper of the car, a wide rubber-covered belt carries it to a storage point

Monel metal, and malleable iron. All these materials are more severe in their effects upon steel turning tools than their hardness and tenacity seem to indicate, or it is difficult to finish them smoothly with a steel tool.

It is said that economical results are obtained also in turning cast iron, at least

can be attained without damage to the tool or to the work.

Two types of diamond are used for tool points. One form, which comes from Brazil, is a conglomeration of microscopic crystals. Most of these stones are black, but some are dark green, brown or yellow. The black stones are known as carbon, and

Unloading Railroad Gondolas With Portable Device

A NEW portable conveying device can be used to unload easily any type of material which is ordinarily carried in hopper-bottom railroad cars. The unloading of such materials as sand, gravel, coal, coke, and crushed stone has always been expensive, as far as labor and time are concerned.

The unloader operates on top of the rail, (Please turn to page 563)

Industries From Atoms

A Department Devoted to the Advancements Made in Industrial and Experimental Chemistry

Research Extends Application of Gas Fuel

WHEN the electric light began to displace illumination by gas, the general public was inclined to foresee diminishing profits in the sale and manufacture of gas.

given location to the best economic advantage. Other work centers around the details of the distributing system, such as proper pipe joints, high-pressure distribution, improved gas holders, et cetera.

Considerable work is also being done by the Bureau of Standards on the subject of

or longer exposures cause extensive attack and even complete perforation of the nasal septum. This is painless, however, and the operator may be entirely unaware of the perforation.

While, therefore, there is a real hazard in chromium plating, it is not critical and can be entirely eliminated by suitable measures. These should include an effective system of ventilation, wearing rubber gloves, aprons, and shoes, and prompt treatment of cuts and abrasions on the skin of workers.

Ozone Increases Cotton Tensile Strength

TENSILE strength of cotton textiles is surprisingly increased by exposure of such fabrics to ozone at a baking temperature, according to P. B. Cochran and H. J. Graham of the Westinghouse research staff. A concentration of 0.5 percent ozone will cause a 20 percent increase in half an hour at 110 degrees Centigrade, (230 degrees Fahrenheit). Acceleration may be obtained by increasing either the ozone concentration or the baking heat; or a concentration as low as 0.1 percent may be used if the temperature be raised to 150 Centigrade. A tensile increase of 25 percent was noted for cotton twine. It is believed that the process might be economically feasible for improving the tensile strength of many cotton textiles.

Fumes Produced in Blasting

DYNAMITE used in underground blasting must produce the least possible amount of poisonous fumes in order that the hazard of asphyxiating workers at the tunnel face may be reduced to a minimum. In an investigation being conducted by the Pittsburgh Experiment Station of the United States Bureau of Mines, in cooperation with the Hercules Powder Com-



A view in the testing laboratories of the American Gas Association, where research work on the heating values of different grades of gas is carried on

While everyone realizes vaguely that the gas companies have continued to grow, the extent of their expansion is not generally appreciated. Industrial uses for gas have been developed to such an extent that they constitute a major outlet for the gas manufacturer. Because of its convenience, complete combustion, absence of ash, and the readiness with which it is regulated, gas is claimed to be "the ideal fuel" and because from the economic standpoint, the production of gas and by-products from bituminous coal is a much sounder proposition than direct burning of that coal, chemical engineers look forward to an ever growing use of gas both for industrial and domestic heating and refrigerating purposes.

The efficiency of the modern gas plant in producing gas from coal and oil is about 75 percent as compared with an efficiency of 20 percent in the modern electric plant. When all factors of investment, distribution, and efficiency of consuming apparatus are considered, it is claimed that gas produces more energy than an equivalent amount of electricity. These figures were presented to the Michigan Gas Association Convention by Walter C. Beckjord. The speaker pointed out that research into methods of distributing and utilizing gas would eventually result in a gas industry of proportions undreamed of at the present time.

Among the research problems being attacked by the gas industry is a study of gas-making qualities of American coals which involves a study of the by-products as well. This work should enable the gas industry to select the proper coal for any

pipe corrosion, which constitutes an important item in gas plant maintenance. If oxygen could be produced cheaply enough (three dollars to five dollars per ton) it is believed that the oxygen could be used in water-gas production to make the operation continuous instead of intermittent.

Health Hazard in Chromium Plating

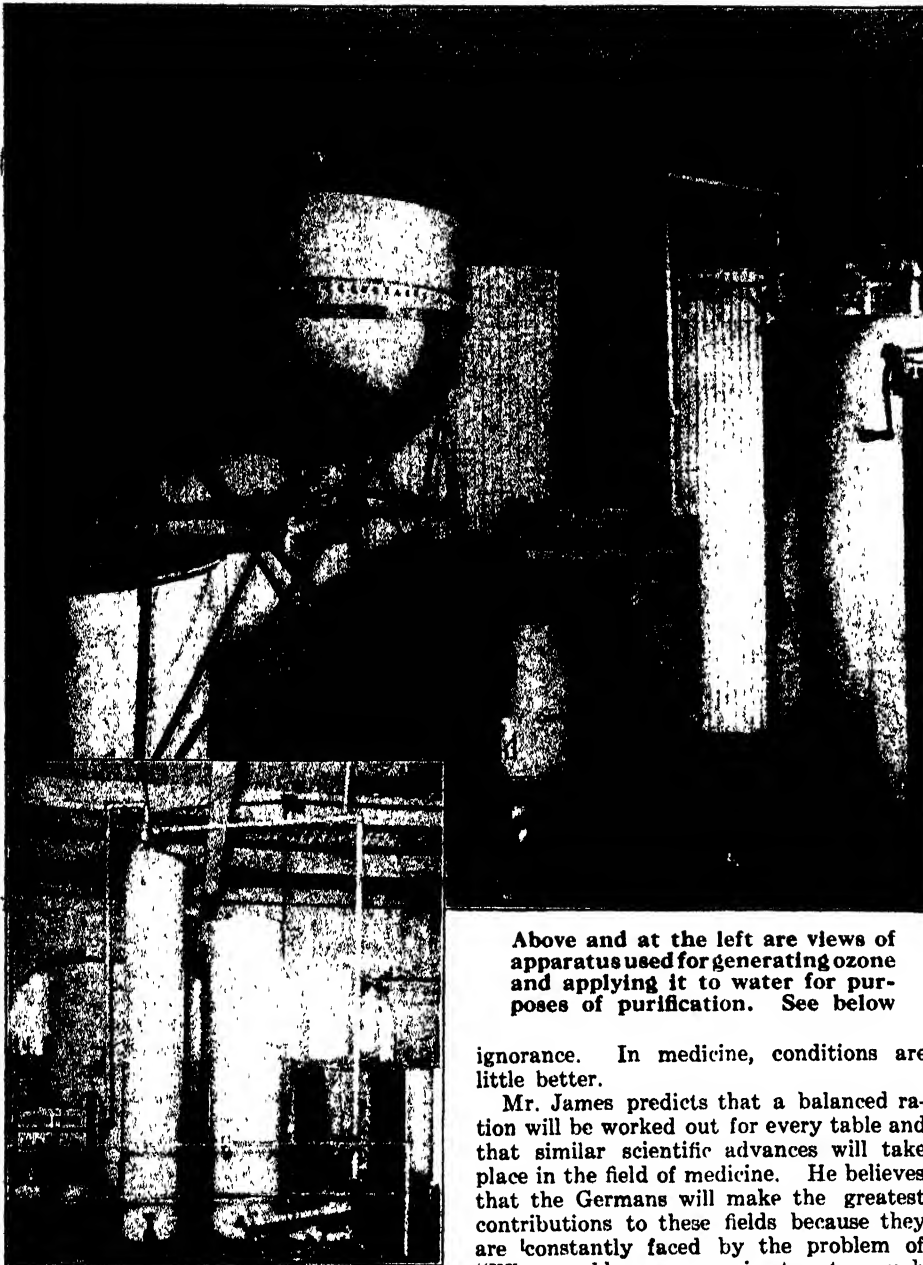
WITH chromium plating flashing on the radiators of many modern automobiles, invading the bathroom on plumbing fixtures, and otherwise becoming generally familiar to everyone, the recent report on the health hazard in chromium plating by J. J. Bloomfield and W. Blum before the American Chemical Society is of timely interest.

The bath used for chromium plating consists principally of chromic acid. During the plating process considerable hydrogen and oxygen are liberated, and these carry a spray of chromic acid into the air. It has long been known that in the manufacture of chromic acid and chromates the operators are subject to attack and perforation of the nasal septum. Formation of ulcers or "chrome holes" upon the hands or other exposed parts of the body often results.

It was found that exposure to very low concentrations of chromic acid—for example, one milligram in ten cubic meters, or one-sixteenth of a grain in 350 cubic feet (which is about the volume of air breathed by a worker in eight hours)—is sufficient to cause nosebleed and nasal inflammation in a week or less. Higher concentrations



Iodine pentoxide apparatus for determining completeness of combustion, built by Bureau of Standards for American Gas Association



Above and at the left are views of apparatus used for generating ozone and applying it to water for purposes of purification. See below

pany, experimental blasting tests are being made with a series of specially prepared dynamites of varying chemical composition in order to determine the mixture that produces the least possible fumes.

A blast is fired in a tunnel which is bratticed off so that the gases from the detonating explosive are confined in a relatively small volume. Samples of the atmosphere in the tunnel after the blast are taken for analysis by men wearing breathing apparatus. The toxic gases produced by dynamites are found to be mainly carbon monoxide and oxides of nitrogen. The amount of these gases produced depends upon the composition of the explosive and the method of loading, factors which are being investigated by the Bureau of Mines. Modern gelatin dynamites produce relatively small quantities of fumes.

Claims "When Do We Eat" is Strongest Urge to Research

THE great inventions in the near future will be in food and medicine, predicts Christopher James, in *Advertising and Selling*. Mankind has pretty well caught up with its needs in transportation and communication, but people are still abominably fed, and the victims of fads and

ignorance. In medicine, conditions are little better.

Mr. James predicts that a balanced ration will be worked out for every table and that similar scientific advances will take place in the field of medicine. He believes that the Germans will make the greatest contributions to these fields because they are constantly faced by the problem of "Where and how are we going to get enough food?"

New Apparatus Uses Ozone to Purify Water

ORDINARY city water is, of course, supposed to be potable, which means that it is free from B. coli and dangerous bacteria, although the bacteria count may be as high as 1000 per cubic centimeter. Treatment with ozone is said to eliminate practically all bacteria. Usually the only ones to be found are a few of the more hardy spores which are not at all dangerous, such as the hay bacilli. In addition to this, ozone treatment will remove any foreign tastes or odors such as that contributed by chlorine and will also oxidize a high percentage of any organic matter which may be carried in solution in the water. This organic matter is picked up, from leaf mold and other discoloration, as the water travels through the earth. The treatment with ozone delivers a water of crystal clearness free from bacteria and with a very low organic content.

There are many methods of producing ozone, but only a few have any commercial value. Competent authorities agree that the most practical means for ozone produc-

tion is from the action of an electric brush discharge which occurs when a current is passing between two electrodes through an air gap and a solid dielectric. The brush discharge is characterized by its peculiar noise, its blue-violet color, its gentle flow, the production of the so-called electric wind, and above all by its remarkable property of converting oxygen into ozone.

The apparatus illustrated uses this method of producing this extremely active gas which is then bubbled through a column of the water to be treated. The same apparatus has been adapted to the purification and deodorization of air and for the purification of water in swimming pools. Manufacturers of bottled beverages are turning to this method of insuring the purity of the water they use.

Rubber-Cellulose Combination Used for Coated Fabrics

INTEREST in the reference made in these columns a few months ago to a new material produced by a combination of rubber and celluloid prompts the publication of this formula that is in commercial use for making a waterproof coating for fabrics used in the raincoat trade.

Dope Solution

	Weight Percent
Cotton Wet	12
Benzol	53
Hexalin acetate	35
	100

Rubber Solution

Raw rubber	8
Hexalin acetate	37½
Benzol	54½
	100

Pigment Mixture

Pigment	50
Castor Oil	50
	100

The spread coating is made with the following combination:

	Parts
Dope solution	25
Rubber solution	15
Raw castor oil	8
Pigment mixture	5
	53

This product when applied to cotton produces a fabric which is extremely flexible, very smooth, and absolutely waterproof.

The term "cotton wet" used to designate one of the ingredients in the dope solution is not a rubber one but is fairly common in the lacquer industry. It signifies nitro-cellulose in a solution of 30 percent by weight of denatured alcohol. The product is handled commercially in this form because of a ruling of the Interstate Commerce Commission.

Wood Preservatives Prove Effective in 15-Year Test

WOOD preservatives are generally known to add remarkably to the life of timbers exposed to the elements, but it is not often that quantitative data on their effectiveness becomes available because such tests must of necessity extend over a long period of years to be conclusive. Hence, the careful experimentation reported in *Wood Preserving News* by the

(Please turn to page 558)

Learning to Use Our Wings

This Department Will Keep Our Readers Informed of the Latest Facts About Airplanes and Airships

CONDUCTED BY ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York City

Aviation Safety Congress

THE Daniel Guggenheim Fund for the Protection of Aeronautics has, since its inception, made safety in aviation the object of its main efforts. Recently the Fund organized a Congress on Safety in Aviation, arranged in co-operation with the National Safety Council, and held at the Hotel Pennsylvania in New York City. The program of the Congress is a proof of the fact that safety in flying is not a matter of one invention or method, but lies in the development of many divers aids. Thus the sessions of the Congress dealt with Structures and Materials in Relation to Aviation Safety; Airports and Airways; Aids to Navigation; Medical Aspects; Aerodynamics; Power Plants; Operation of Aircraft in Air Transport; Weather Service; The Public and Flying; and last but not least, Fire Prevention.

The sessions were attended largely by technical men, but the lay public was also well represented. In several of the sessions, members of the public would rise to ask how safe aviation really is.

Perhaps the best answer made to this question was that of Senator Hiram Bingham, the new president of the National Aeronautic Association. The Senator, who occupied an important position with the Army Air Service during the World War, and has since been a potent factor in aeronautical legislation, said that we could have any kind of safety that we wanted, just as we could have any kind of safety in going by water around Cape Cod. In a row boat, there would be considerable danger. A fishing sloop would be far from safe. An ocean liner would be perfectly safe. So in aviation, we could range from great hazard in the flying of unlicensed craft, manned by inexperienced personnel, to the safety approaching that of a railroad on the regular passenger lines operated by the great air transport companies.

The Congress achieved a great success in bringing the exact elements of aviation safety before the public and in placing

squarely before the technicians the present status and the future needs of safe flying.

Experiments in Fog Flying

FOG flying attracted due consideration at the Aviation Safety Congress. The Fund has made the conquest of fog one of its major projects. Lieutenant James H. Doolittle, of the Army Air Corps, one of the most experienced test and research pilots in the country, and winner of the Schneider Seaplane Cup in 1925, has been secured by the Fund for a series of systematic experiments in fog flying. A special plane with dual control will be placed at his disposal as well as every possible instrument or device likely to be of service in blind flying. The action of such devices will be tried out in fair weather, with one pilot closed in his cockpit. The "blind" pilot will attempt first to fly by instruments alone, then to land "blind" by the aid of special height indicators, based on electrical and acoustic principles. The experiments will then be repeated in an actual fog, under flying conditions. This work will certainly test even Doolittle's iron nerves.

Altitude Flights

OUR photograph shows E. T. Allen, test pilot for the Boeing Company of Seattle, Washington, clad in leather and fur, with face mask, goggles, and oxygen tube glued to his lips, just as he would appear at an altitude of 30,000 feet or so above the ground.

In military or naval aviation, altitude gives the flier a great advantage. At very great heights, he is safe from observation and from anti-aircraft guns. Swooping down from altitude on an enemy pilot flying in a lower zone is a formidable maneuver.

The single seater pursuit built by the Boeing Company, not only attains a height of 30,000 feet, but it can fly at 180 miles per hour with full military equipment. The new pursuit ship has excellent lines and is

very "clean." After tests it is to be turned over to the Navy Department.

Accident Causes

IT is interesting to read the classification of aviation hazards presented by Mr. Ted Wright, Chief Engineer of the Curtiss Company. Twenty percent of all accidents are caused by forced landings due to engine failure. This classification includes engine failures caused by breakage or non-func-



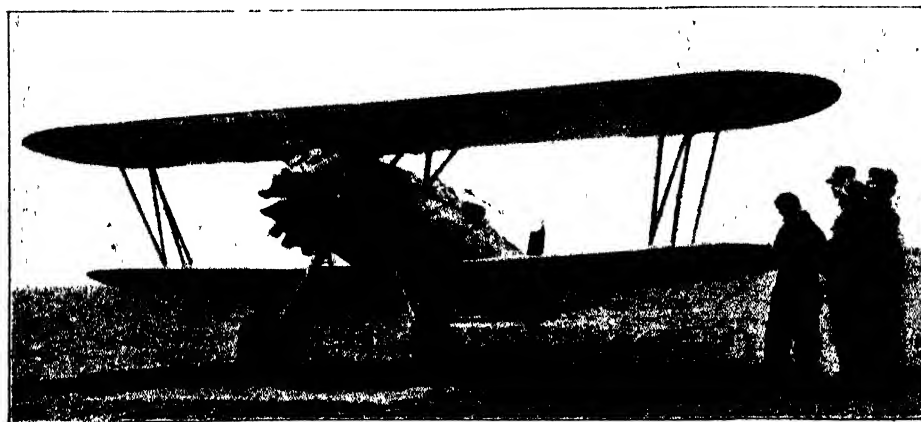
E. T. Allen, test pilot for the Boeing Company, as he appears at an altitude of 30,000 feet, equipped with apparatus for breathing oxygen.

tioning of the engine proper, or of the auxiliary systems such as fuel, ignition, cooling, or carburation. Approximately the same percentage of failures occurs in each of the above sub-items.

Mr. Wright advocated as remedies the use of multi-engined airplanes, capable of flying with one or more power units disabled; provision of a more dependable power plant; and provision of more landing fields throughout the country.

Errors of judgment by the pilot are responsible for 53 percent of accidents. We believe that this estimate is far too high. It is sometimes very difficult to determine the causes of an accident. There is a temptation for investigating boards to blame the pilot, particularly when the pilot is dead and not able to defend his reputation. The accident may really have been due to instability, insufficient control, too high a landing speed or other deficiency in design.

It may be argued that the pilot should



Because of the value of altitude in military and naval flying, experiments are being carried out with this Boeing plane, capable of reaching 30,000 feet

realize these deficiencies and fly his ship so as to take account of them. That is asking perhaps too much from even skilled flyers. The remedy lies partly in better training, partly in better design of our airplanes.

Weather conditions were estimated by Mr. Wright as being responsible for 19 percent of all accidents. These include chiefly accidents due to severe storms, lightning, fog, ice formation, et cetera. More meteorological stations and better

the ship can be turned completely around in a space no wider than a city street, or held almost stationary in the air.

The airship has always been regarded as a naval or military weapon and as a medium of long distance transportation. It has never been considered as of possible usefulness in aerial service, while the airplane has been put to work in dozens of industrial applications. The Meadowcraft airship with its small size and extreme maneuver-

the Wasp engine actually turns up more revolutions with the muffler than without it.

Runways for Airports

THERE is now a special publication devoted to the construction and operation of airports and appropriately termed *Airports*. A most interesting series of articles starting in a recent number is that dealing with runways.

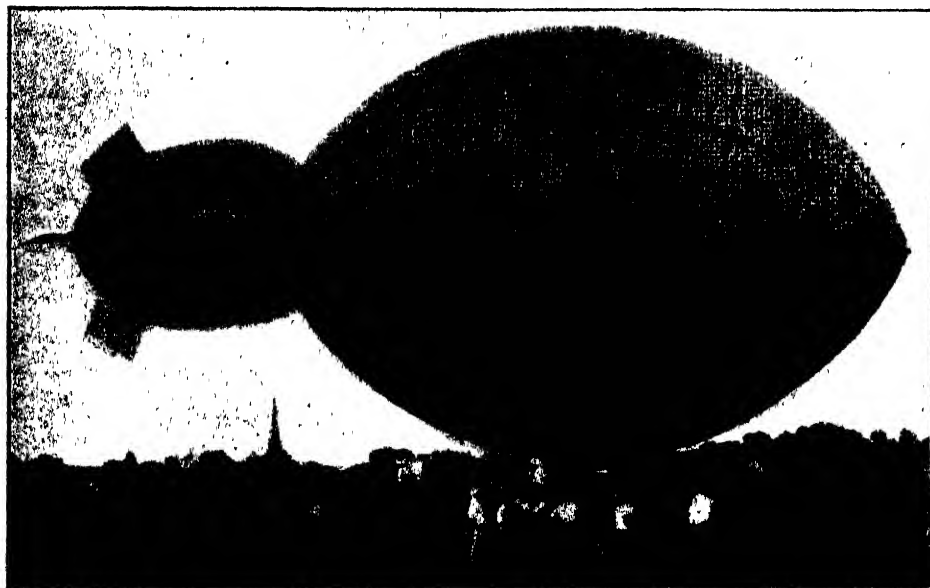
Where the soil is such that dry weather does not make it dusty, if there is sufficient drainage to keep it from getting muddy or wet, and until the traffic gets heavy, the natural soil scraped clear of vegetation serves all purposes. But where these desirable conditions are not available and air traffic is heavy, artificial runways become necessary. Asphalt, brick and concrete each have their advocates. For each of these, firmness and uniformity, smoothness, good visibility, and durability are claimed. Experience alone will decide their relative merits. In the meantime, civil and highway engineers and manufacturers of these three materials will have many arguments about their respective merits.

A Rubber-Hydraulic Landing Gear

THE design of an airplane landing gear is quite a difficult matter. An axle between the two landing wheels may get caught by an obstacle on rough ground and tend to nose the airplane over. Therefore, the transverse axle has disappeared in most modern designs. It has evolved to a short, stub-like affair to the end of which are connected three struts, as shown in our photograph of the Stearman landing gear.

The landing loads may come on the chassis from any direction. There is always a vertical load as the wings lose lift and the plane settles on the ground. There may be a side load, if the landing is made with one wheel lower than the other, or if there is a side wind. There may be a force in a backward direction if the plane meets an obstacle of any kind on the ground. The struts, therefore, are so arranged that they can take loads in any direction.

In the Stearman landing gear, the two inclined struts are hinged at the center of the fuselage, and take up the side and backward loads. The outer strut is a shock absorbing member which compresses through



What is said to be the world's smallest airship has a strange resemblance to a misshapen potato. It has a lifting-gas capacity of only 22,000 cubic feet

weather service, particularly by the use of radio communication, will do much to remove these hazards.

Finally, 8 percent of accidents are due to structural failure. The structural design of the airplane is very advanced, which accounts for the low percentage. The worst of structural failures is that they are apt to involve fatal results, and also that they cause the greatest blow to morale. Accidents due to weather are taken somewhat for granted in all human activities. There is, on the other hand, something particularly disquieting in the report of a fatal accident due to the loosening of a wing in the air. The remedy here is in still more careful structural analysis of the airplane, in rigid inspection during manufacture, and in better maintenance.

While Mr. Wright's paper dealt especially with structural analysis and design, it really gave a bird's eye view of the entire problem of aircraft safety, and was all the more valuable on that account.

World's Smallest Airship

THE Meadowcraft Balloon and Airship Company have recently built what is the smallest airship of to-day. It is 65 feet long and 30 feet in diameter, and has a gas capacity of only 22,000 cubic feet. With a 22 horsepower Henderson motorcycle engine it attained a speed of 20 miles per hour. It has a weight empty of 800 pounds and can carry 500 pounds of useful load.

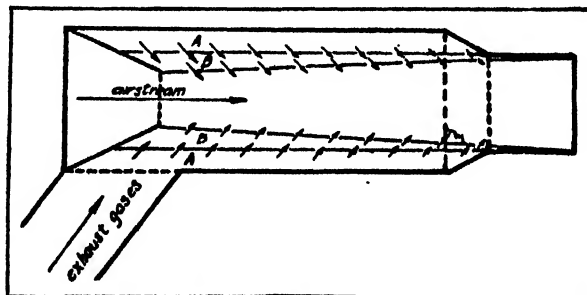
The airship is non-rigid of course, and consists of two lobes. The front lobe is the main lifting unit; the rear lobe is jointed and serves to give both directional and horizontal control. This is an entirely novel idea, and the control obtained is very powerful, according to *Air Travel News*,

ability has possibilities for such work as aerial advertising, aerial photography and insect control. With its ability to hover over one spot, it has, for certain phases of such work, an obvious superiority over the airplane. Its employment for such purposes may mark a new phase of airship utility.

A New Type of Silencer

THE new Loening cabin amphibian, Wasp engine powered, is a remarkable plane, whose many excellent features we hope to describe in detail at a later date. The muffler is particularly interesting. It consists of three concentric cylinders, the

Right: Diagrammatic sketch of new exhaust silencer. The exhaust gasses enter at one side, and are caused to swirl as they expand and pass from chamber A to B, and then into the air stream and the outer air, with little noise

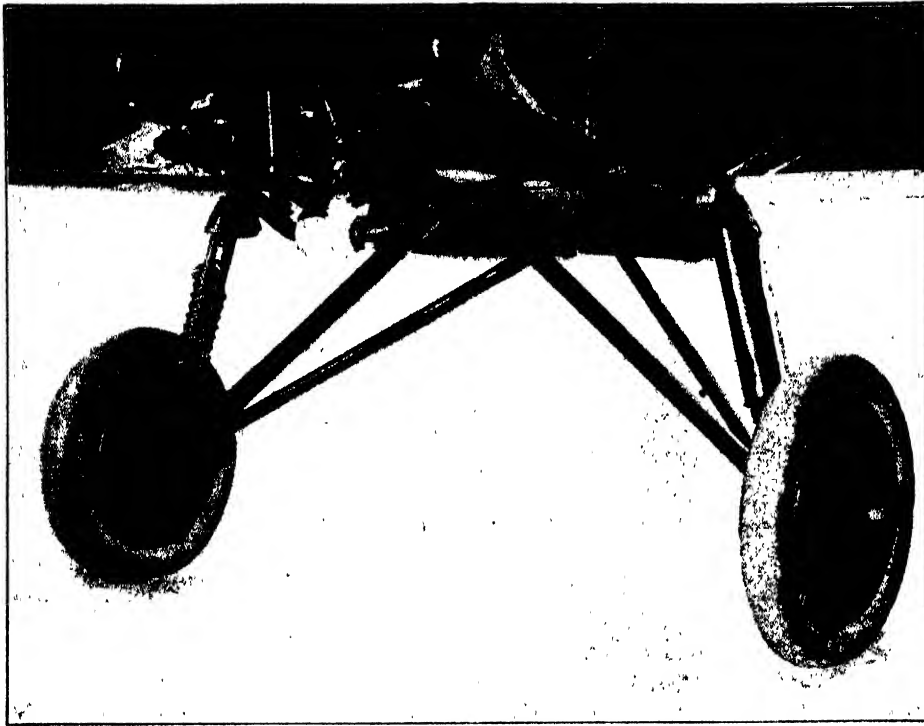


inner two perforated. The exhaust gases enter on one side, and therefore whirl as they expand. The innermost cylinder consists of two truncated cones, producing a Venturi effect.

The gases pass from the chamber between the outer two cylinders to the one between the inner two cylinders and then inside the inner cylinder. In the process the flame and noise of the exhaust is reduced. At the same time the Venturi effect gives suction instead of the back pressure which is customary with mufflers. As a result

several inches so as to lessen the shock. A study of the photograph will show that the wheels will swing up and out as the compression strut is shortened. The design of these compression struts has passed through many stages of evolution, and they are now generally a combination of a hydraulic system and a spring or rubber system.

For a given weight, rubber is the material which will take up the greatest energy of shock. It is so elastic that it has far better shock absorbing properties than the best of steel springs. Up to two or three years



The new Stearman landing gear, in which the shock is taken up by a combination hydraulic and rubber shock-absorbing system. See text in these columns

ago, rubber was used as the sole shock absorbing element. The rubber, in the form of cord or disks, took up the initial shock admirably. Unfortunately, the energy stored in the rubber is only partially destroyed during its absorption; therefore after a severe landing the airplane tends to rebound. Hydraulic shock absorption does away with this rebounding tendency.

In the Stearman "rubber-draulic" gear, the hydraulic unit consists of a piston with a small orifice operating in a cylinder full of oil. As the strut compresses and the piston travels upwards in the cylinder, the oil is forced through the narrow orifice, energy is dissipated thereby, and converted into heat without the possibility of reconversion into energy of rebound.

After the landing shock has been absorbed by the hydraulic system, taxiing loads are taken up by rubber shock absorber cord in tension. This cord is a continuous piece wound around a series of pins welded to the frame of the gear, and extended as one part of the compression strut. The part fixed to the wheel moves upward relatively to the part which is fixed to the rest of the airplane. The greater the travel in compression, the less the load actually transmitted to the fuselage of the airplane, and in this particular gear the total travel is eight inches, of which six inches is taken by the hydraulic portion. An average grade of lubricating oil is used in the cylinder, but in winter a zero oil is employed.

Aerology at the Airport

NOTHING is more important for air transport operation than efficient weather service for the pilot. We are glad to see therefore how seriously the matter is treated at the Brook Park Airport, of Cleveland, Ohio. One of our photographs shows L. E. Pierce, in charge of the aerological office at this airport, on top of one of the hangars, about to launch a meteorological balloon. This is similar in appearance to a toy balloon, but larger, inflated with hydrogen, and far more buoyant. Such

a balloon when properly inflated will rise at a predetermined rate, which is 550 feet a minute as a rule.

With a telescope and sextant, Pierce observes the course of the balloon in flight and by plotting its course in all three dimensions, can determine both the velocity and direction of the wind at various altitudes. Temperature, barometric pressure, condition of weather, ceiling, and visibility are other meteorological data recorded at frequent intervals at this and other stations. The data from all stations along a given route are recorded on a large board in the hangar and serve to give a pilot invaluable information before his flight.

The Goodyear "Puritan"

IT is possible that small airships will really be the first air-borne craft to land consistently and in safety on the roofs of our cities, a feat recently accomplished by the Goodyear *Pilgrim*. A sister ship of the *Pilgrim*, the Goodyear *Puritan*, has a gas capacity of 86,000 cubic feet of helium, and is powered with two Ryan-Siemens five-cylinder radial engines, which can drive the ship at a maximum speed of 55 miles per hour. The engines are mounted on outriggers, so that the cabin is insulated as much as possible from their noise and vibration. The framework of the car and keel are built of duralumin girders, almost exactly like those to be incorporated in the 6,000,000 cubic foot airships now on order. The passenger cabin is built of sheet duralumin over the girder framework, and is shaped very much like a flat iron. The keel is contained inside the envelope, making the cabin an integral part of the bag.

Non-rigid airships used to have their cars suspended by a net work of cables which increased head resistance. This is avoided in semi-rigid airships, and we believe that the *Puritan* really belongs to the class of semi-rigid airships. One of the innovations in design is a single landing wheel projecting below the center of the cabin. This wheel, mounted on a duralumin frame, acts as a support for the ship when it is on the ground, and permits easy rolling from one place to another. Because the airship is lighter-than-air, the wheel receives very little load on the ground.

(Please turn to page 556)



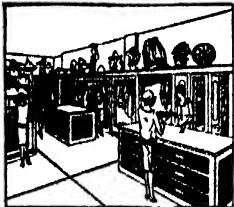
Releasing a sounding balloon



The Goodyear *Pilgrim*, sister ship to the *Puritan* described above, has a gas capacity of 86,000 cubic feet and is powered with two five-cylinder engines

Industry after industry discovering new uses for this *grainless* wood board

Read the story of its wide and steadily increasing uses. Read about its remarkable workability, uniform strength, high resistance to moisture, and many other advantages. Then send for large, free sample of Masonite Presdwood, and put it to the test yourself.



FOR STORE FIXTURES

Here is a product which is writing a new page of progress, and in scores of industries meeting challenge after challenge of modern manufacturing.

Think of it!—genuine wood board that is absolutely grainless! A board that will not crack, check, split or splinter! A board of uniform strength and truly remarkable workability!

And yet these are only a few of many advantages of Masonite Presdwood. It is very dense and tough. It cannot be destroyed by moisture. One face is steel furniture finish for smoothness and the other side has an imitation canvas finish. It requires no paint for protection, and also takes any finish beautifully.

Presdwood is simply wood torn apart, and put together again. It contains no foreign substances of any kind; not even a chemical binder. So it cannot damage tools.

Presdwood comes trimmed to a four-foot by twelve-foot size. It can be used on any wood-working machine; saw, planer, sander, shaper. It can be cut out, punched, die cut and shaped. In fact, you will find that Presdwood is adaptable and workable almost beyond belief.

No limit to its uses

There seems to be practically no limit to the uses for Masonite Presdwood, and new uses are being discovered week after week.

Candy manufacturers are now using Presdwood for starch trays, and in a number of large manu-

facturing plants all the telephone booths are lined with it.

In the Chicago Art Institute it is backing and permanently protecting rare works of art.

The ceilings in the new Pullman Cars of various railroads are made of Presdwood; so is flooring for dance halls and pavilions.

Packing cases, concrete forms, radio cabinets, incubators and bowling alleys—these too, are being made of Masonite Presdwood.

And store fixtures of all kinds, bedroom screens, invalid trays, shelving, work-bench tops, table tops, clothes hampers, bread boxes, cupboards, breakfast nooks and china closets!

Campers' tables, automobile bodies, safety wheels for bathing beaches, speed boats, highway signs and entrance signs, all these too, are made of Presdwood!

Send for free sample

Write for a large, free sample of Masonite Presdwood, and find out what it will do for you. It may be the very material for which you have long been looking. It may enable you to make a worthwhile improvement in your product, and at the same time lower your operating costs to a marked degree. Try Presdwood for yourself!

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IN BUILDING BOATS



Strays From the Ether

A Monthly Review of the Progress Made In All Branches of Radio Communication

Television Abroad

AS noted in our November issue, Albert G. Ingalls, Associate Editor of the SCIENTIFIC AMERICAN, is traveling in Europe at the present time, collecting material on various scientific subjects, and arranging for articles that will appear in future issues. The following information on television as developed in England was rushed to us just in time for publication in this issue. As



The Baird television transmitter as used on board ship for tests of transmission over distances

Mr. Ingalls witnessed demonstrations of the apparatus, he is qualified to give an authentic description of the results obtained. —The Editor.

BAIRD, the well-known British inventor, has successfully accomplished two new and interesting things. The first is color television. The second is stereoscopic television.

In addition to these, Baird has refined his system of ordinary monochrome television to the point where standard receiving apparatus in finished form, ready to use, may now be seen in the display windows of London department stores. These are not priced as low, it is true, as a simple radio set but, to give a rough comparison, they cost about the same price as a certain popular American make of motor car.

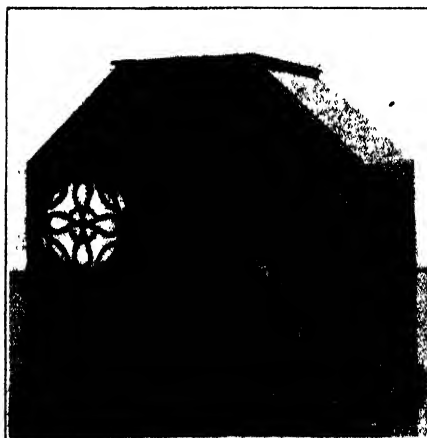
To find out what kind of television Baird is planning to serve up to the British people, I arranged for a demonstration of the exact type of apparatus described. At the transmitting end was a man. One could see and hear him. The man talked, chatted, sang a song, smiled, made some faces, stuck out his tongue and rolled his eyes. All this was clearly visible. As the expression "clearly visible" is some-

what indefinite, it could be said that the man's facial details were easily distinguishable; a fair sized wart would, for example, be discoverable if present.

Baird's television does not appear in the orange-red tone of the ordinary neon tube; it gives the impression of being more like black and white, although close scrutiny shows that it is not just these. What kind of a tube does he employ? No facts were given out. Nor would the demonstrator open the cabinet. This is more or less in accord with a policy generally pursued in Europe—although slowly being modified—of keeping secret various methods of manufacture instead of frankly pooling the results of research as we do in America.

Baird's system of color television—"polychrome" television is the correct technical term—is intrinsically interesting. Whether it has a future or not is another speculation possibly best answered by inquiring whether polychrome moving pictures have a future.

The system is described in detail in Dinsdale's *Television* (Television Press, London, 1928) but is so simple that a few hints will suffice to describe it to those who have even a rough conception of the elementary principles of ordinary television. Instead of the single spiral of holes used with the ordinary disk, the



This commercial television receiver is now available, on order only, to devotees of the art in England

polychrome disk bears three spirals. Each spiral contains 36 holes. This is shown in the drawing. Each spiral corresponds to a different color; namely, green, blue, and red. These are the primary colors whose proper combinations make any desired color or tint. In the Baird apparatus they are used in sufficiently rapid succession to fool the eye. Thus the object or person being transmitted is scanned with a green spot of light, then a blue spot, then a red; and so on. The disk turns 10 revolutions per second.

The colors are obtained by means of ordinary colored light filters attached to the respective spirals, covering the holes.

In effect three separate pictures are transmitted, seriatim. The first contains nothing but the green parts, if any, of the subject; the second only the blue parts; the last the red parts.

The receiving apparatus is not quite so simple; Baird had difficulty obtaining the tubes which would emit light corresponding to the three primary colors. A neon tube provides the red; and the blue and the green are obtained respectively from one tube containing helium and mercury vapor. A commutator mounted on the armature shaft of the disk driving motor switches the neon (red) lamp when the red viewing holes of the receiving disk (which has the same trio of separate spirals as the transmitting disk) are in line with the viewer's eyes and the lamp. When the remaining two sets of holes, the blue and the green, have rotated into position, the helium-mercury lamp is switched on automatically.

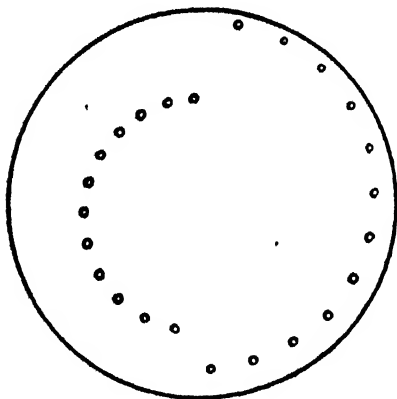
Of course, the use of three colors involves, theoretically at least, a consideration of the necessity either of transmitting three times as many images per second or producing a flutter. However that may be, in practice the rate of transmission is not speeded up, yet there is no very noticeable flutter. The separate colors of various objects came through remarkably well in the demonstration at Glasgow. These were highly colored objects, it must be admitted, yet as the saying goes, "Give it a chance, it is only a youngster."

Another accomplished fact to Baird's credit is stereoscopic television. I was unable to see a demonstration of this because the apparatus was "on tour" in the Netherlands at the time of my visit. It is said that the televised objects stand out in three dimensions with complete illusion. The method of accomplishing this end is altogether simple in principle. The essence of it is that the object is scanned from two separate points of view.



The Baird stereoscopic television receiver. The "looker-in" is viewing image through a stereoscope

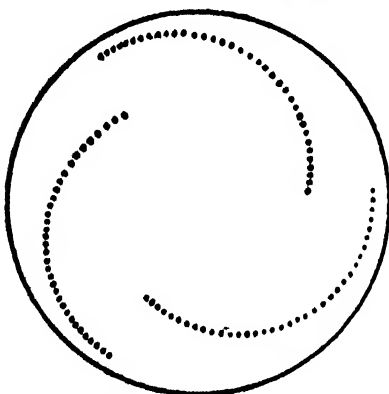
To permit this, the transmitting disk bears two spirals, one near the edge, the second nearer the center—to be exact, about $4\frac{1}{2}$ inches apart. This is not very much more of a spread in point of view



A television disk for reception of monochromatic stereoscopic images

than that afforded by the two eyes of the average human being. It is assumed that the reader already understands the elementary principle of stereoscopic vision.

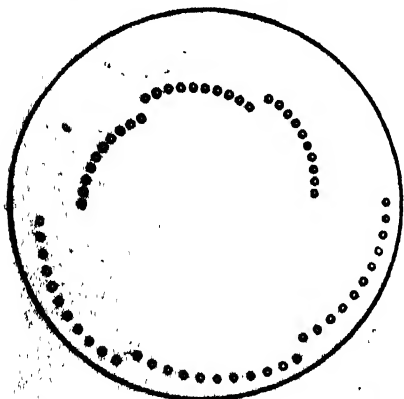
Baird has gone even further; by replacing each of the two spirals of the system described for stereoscopic television by a trio of double spirals (see sketch) he



The three spirals on this disk allow reception of three-color images

has obtained successful *stereoscopic color* television.

Whether Baird's ordinary monochrome television is "better" than some of the American systems is a question which will occur first to many if not all. Admitting first that comparisons are odious, it is difficult to compare phenomena when months have intervened between seeing



Stereoscopic and color television is accomplished with this disk



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POWER saving—profit saving—longer life—faster production—these are the wonders Hyatt Roller Bearings are working in all industrial applications.

Wherever installed on wheels, drives, shafts, gears and motors, smooth running Hyatts transmit power without effort or waste. Practically frictionless they avoid the sticking and drag of plain bearing surfaces.

Equipment lasts longer when rugged Hyatts are employed. Immunity from bearing breakdowns insures faster, smoother production. Attention is confined to infrequent lubrications. Labor and maintenance costs are negligible.

Throughout all industrial applications as well as in railroad, automotive, mining and agricultural equipment engineers have found that the Hyatt-way is the Saving Way.

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Wide World

This Brooklyn amateur, Nat Pomeranz, holder of call 2APD is credited with being the link between this country and Porto Rico during a recent storm which damaged the island. Pomeranz handled messages almost continuously for 48 hours, using both transmitter and receiver during this time

them. In general, the respective results seemed not so much better or poorer as quite different.

How to Powerize Your Receiver

THE practical details of how to convert any receiver over to socket-power operation and super-power amplification—a process known as “Powerizing”—are now available in the folder just issued by the Radio Receptor Company, of 106 Seventh Avenue, New York City.

This booklet covers the requirements for every conceivable set, whether it employs 99 type or storage-battery type tubes, and whether it is totally or partially to be powerized. Thus for the receiver now entirely battery-operated, it is possible to employ a powerizer supplying the “A,” “B” and “C” requirements, as well as super-power amplification. For the receiver already provided with a “B”-eliminator, there is a powerizer which, in combination with A-C tubes and suitable harness adaptor, replaces the messy storage battery without rewiring the set.

For the receiver which must operate with 99 type tubes, there is a powerizer which supplies 3.3 volts for “A,” as well as “B” and “C” voltages, and furnishes super-power amplification. For the receiver with 99 type tubes, such as the Radiolas 25 and 28, there is a powerizer which connects the filaments in series and furnishes high-voltage current from the usual rectifier.

And for radio enthusiasts desiring power amplification of exceptional quality, there are amplifier-powerizers for the home as well as for the auditorium or outdoors. The folder is available for the asking at the address given.

Liquid-Filled Photo Cell

A TUBE which generates electrical energy when sun or other light falls upon it was announced recently by the

Radiovision Corporation, New York City. Engineers of the company believe that the tube may not only bring practical television much nearer, but that it may open up wide fields of experimentation hitherto unexplored.

According to Edgar H. Felix, vice-president of the company, the photo-voltaic cell generates one thousand times the current generated by the present-day photo-electric cell.

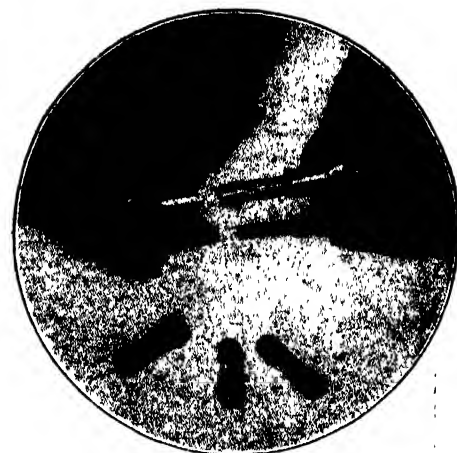
“The photo-voltaic cell is so sensitive that the wave of a hand over it causes its current to vary by a marked degree,” it is explained. “By the use of color filters any color may be made to cause an individual electrical response. This principle may some day be employed for burglar and fire

alarm purposes. The cell will lend itself to spectacular demonstrations, such as turning on the hot water heater, opening the furnace, closing windows at sunrise, and turning on lights when darkness falls, but its real value is in the line of scientific experimentation.

“The cell resembles a large radio vacuum tube filled with a greenish fluid. In it are two plates set in parallel. When properly coupled to a standard two-stage amplifier of a radio receiver, its current fluctuations, produced by turning on and off a 50-watt light, are sufficient to actuate a sensitive relay. Consequently, enough energy is available to control any electrical operation by means of light.

Esperanto As a Radio Language

A RECOMMENDATION that transmitting stations broadcast communications in the Esperanto language to as great an extent as possible was a feature of



Tiny fuses for use in radio sets are now available. They serve to protect various circuits. Made by Littlefuse Laboratories, 1772 Wilson Avenue, Chicago, Illinois

a recent meeting of the International Broadcasting Union. A survey showed that 168 stations in Europe, Asia and the United States sent out messages in Esperanto, it



The art of the tea-taster has been modified and adapted to radio, and now we have the tone tester. The photograph shows Martin T. Olsen, of the Jensen Radio Manufacturing Company, and who in a recent test, it was reported, was able to distinguish between audible sounds over the entire musical range

was reported by the secretary. The station at Geneva makes weekly broadcasts in this language.

Various commissions pursued their study of the organization of relays for a wider exchange of radiophonic programs. It was decided to arrange relays between Germany, Austria, Poland and Czechoslovakia. Announcement was made that considerable technical progress has been achieved in relaying musical programs by employing submarine cables between Great Britain, Belgium and Germany.

Morocco Has Radio Beacon

SPAIN has established a radio beacon at Cape Tres Forcas, Morocco, the first to be placed on the coast of Africa, the United States Lighthouse Service announced recently. It is expected that another beacon will be installed at Cape Spartel, south



At a recent German radio exposition this huge loudspeaker was demonstrated. It is built into the mantelpiece above a fire place, and is ornamental as well as effective

of the entrance to the Mediterranean Sea. The beacon at Cape Tres Forcas transmits the letters TF, followed by a long dash of four seconds' duration. The signal is transmitted by a continuous wave on the 300-kilocycle band.

Television Motor

FOR experimenting with television receivers, it is necessary that the motor employed for revolving the perforated disk be of such a type that its speed is continuously variable, and that there be no sparking anywhere in the machine.

Such a motor has recently been announced by the Interstate Electric Company of St. Louis, Missouri. The motor is made in two sizes, the six pole type for a speed range of 50 to 1100 revolutions per minute, and the four pole type being variable from 100 to 1700 revolutions per minute. There are no brushes, commutator, automatic switch or any other device that can spark. The shaft runs on ball bearings, insuring minimum friction and quiet running.

Get rid of money worries for good!



TWO MEN were talking in a club-house reading room.

"Everything's going pretty well with me—now," said one of them. "I make enough money to pay the bills, enough even to take a vacation now and then. But I sometimes wonder how it would be if anything happened to me. I know perfectly well the house might be sold, my son taken out of school..."

The other man smiled.

"That's just the way I was fixed," he said. "And then a funny thing happened. I answered an advertisement and got hold of a copy of the Phoenix Mutual 'Prosperity Plan.' Maybe you've heard of it. I filled it out.

"I was paying 6% interest on our mortgage at the time. The Phoenix people showed me how by paying only about 1½% more I could fix it so the bank would hand the home over to my wife clear of debt. That was the end of that worry."

"Then they made a special arrangement that will put Jimmie through college. That fixed that. And just recently they fixed up what they call an 'income agreement'—and now the family will have an income of \$100 a month after I'm gone."

"So the only things I had been worrying about are taken care of—and all because I filled out that little piece of paper!"

~ ~ ~

WOULDN'T you like to make *your* life plan financially foolproof? Wouldn't *you* like to get rid of money worries for good?

You can. The coupon at the bottom of this page will bring to you, free, the remarkable Phoenix Mutual "Prosperity Plan."

Sending for it is the first step towards real independence—protection for you and your family no matter what happens—an education and every advantage for your children—leisure and comfort for yourself in your later years.

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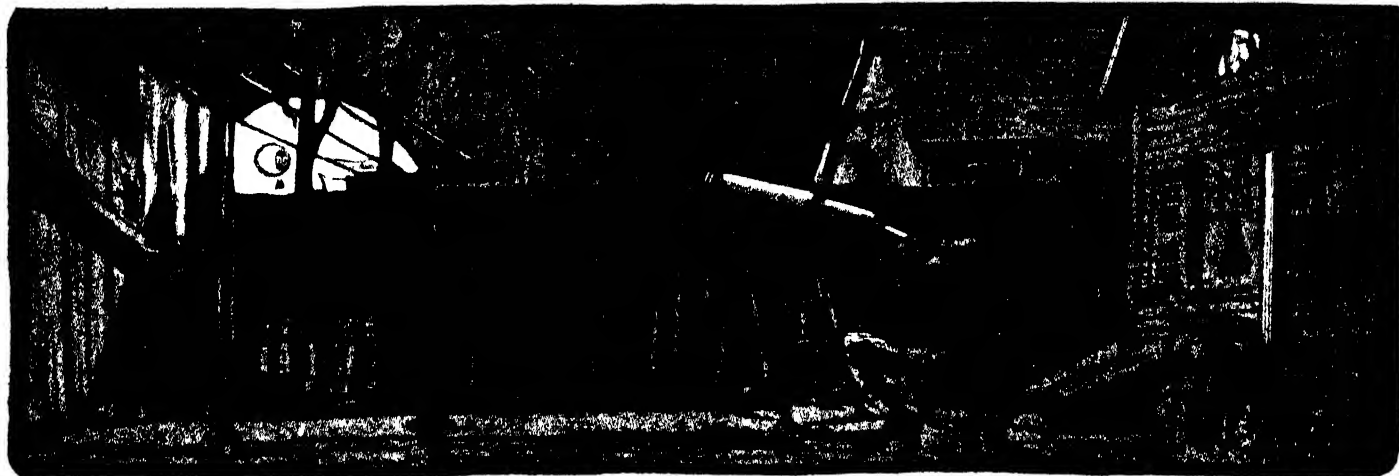
HERE are just a few of the things you can do under the Phoenix Mutual Plan:

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- 2 REALLY own your home.
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- 4 CREATE an estate.
- 5 MAKE sure your income will go on even though you become totally disabled.
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Send me by mail, without obligation, my copy of your "PROSPERITY PLAN"

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The Back Yard Astronomer

A Department Devoted to Interests of the Amateur Telescope Maker

A. R. DUNLOP, Box 745, New Westminster, British Columbia, sent in some time ago a photograph of his telescope, which we reproduce. Visible beside the reflector, which has a 12-inch mirror, is



Mr. Dunlop's 12-inch reflector telescope and solar observatory. In the house is a spectroscope

a small building which he has been using to enclose a spectroscope for study of the Sun. Mr. Dunlop writes:

"I feel almost certain that there are dozens of amateurs who could take a lot of pleasure in making a solar spectroscope and watching solar prominences. I do not think there are many amateur astronomers and telescope makers who would not become intensely interested if they saw some of the objects I have seen on the Sun. It is quite common to see great masses of gas shoot up 75,000 or 100,000 miles high, then die away to nothing in a few hours. The forms they take are varied and graceful, in fact no two are ever just alike. Sometimes they are like spikes, again they resemble jets or plumes, or a basket of flowers, and sometimes they look just like ordinary clouds. The latter are termed quiescent prominences, and often look somewhat the same for a long time.

"My experience with small star spectroscopes quite confirms your statement that they are not satisfactory on small telescopes. I do not get very good results even using my 12-inch reflector. I can see only a few lines in bright stars, but even that is of

some interest. I did not know whether the replica grating would work well for solar work or not until I tried it, but I ordered one and have been using it about a year, and it works.

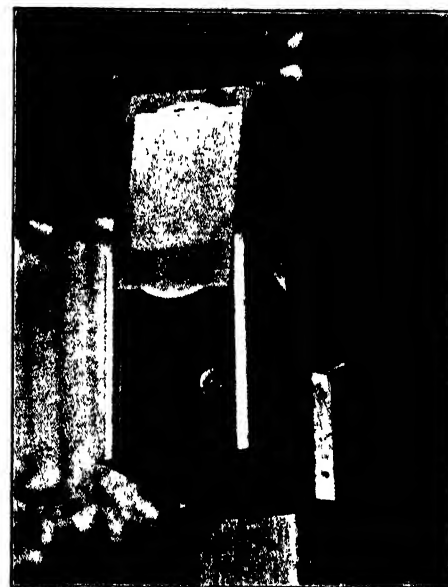
"I am now trying to find out where I can get a larger one and a few more hints on spectroscope construction before I start on a Hale spectrohelioscope."

Since Mr. Dunlop sent us the above letter, Dr. Hale's description of the spectrohelioscope has appeared in the new edition of the SCIENTIFIC AMERICAN book "Amateur Telescope Making," and Mr. Dunlop advises us that he expects to convert his equipment into a spectrohelioscope, using the blueprints mentioned in the book and housing the apparatus in the structure shown in the illustration. All the solar ac-

tivity he describes, and more, can be observed to far better advantage with the new apparatus which can be made at moderate cost.

Harold A. Lower, 1032 Pennsylvania St., San Diego, California, made a telescope which he has used successfully for lunar photography. Mr. Lower writes:

"My telescope was made from the instructions in 'Amateur Telescope Making.' The making of the mirror is so well covered



A close-up of the photographic equipment used on Mr. Lower's telescope shown at the left below



Mr. Lower's telescope with camera attached at the upper end of tube

in the book that comment on it is unnecessary. The mount is the German equatorial type and is made from the front hub assembly of an old auto. The only thing needed to adapt it to its new use was to remove the steering spindle bushings and replace them with solid plugs, which were then bored at right angles to the wheel spindle. The wheel spindle forms the polar axis, and as it is mounted on ball bearings it moves very smoothly and easily.

"The telescope tube was made of wood, as in this location the mirror and prism do not fog as quickly in a wooden tube as in

one of metal. There is usually a very heavy dew fall here in San Diego, and the wooden tube enables one to use the telescope when an instrument with a metal tube would be almost useless.

"The setting circles are made from printed paper disks which were purchased for 20 cents each, from a dealer in engineering supplies. They answer the purpose very well.

"The box over the eyepiece is used only for photography, and is easily removed when the telescope is used for visual work.

"I will be glad to get in touch with anyone else who is interested along the same lines that I am."

When the Editor expressed a desire to publish more details about the use of the telescope for lunar photography, Mr. Lower furnished the following statement:

"I have found that it is easy to photograph the Moon with a home-made telescope. A box, open at both ends, is mounted on the telescope over the eyepiece, to hold a plate holder or a ground glass for focusing. An eyepiece of about one-inch focal length is used, partly to magnify the image, and partly because it is more convenient to



From far off Dutch East Indies comes this picture of Mr. de Jager working on his telescope mirror

focus with the eyepiece than to adjust the plate at the focus of the mirror. One should not have the plate more than three or four inches from the eyepiece, as a large image will require too long an exposure.

"I use Eastman cut film, Super Speed, instead of a glass plate, as it is very fast and does not show a halo around a bright object, as do ordinary glass plates. The cut film is placed in a sheet metal adapter and loaded in a plate holder just like a glass plate.

"No shutter is required. A sheet of cardboard is placed over the front of the telescope after the image of the Moon has been focused as sharply as possible on the ground glass. Then a film holder is substituted for the ground glass, the slide is removed, and the exposure made by removing the cardboard from in front of the telescope and replacing it as quickly as possible.

"As Super Speed film is very sensitive, the exposure needed is only about a fifth of a second, which is fast enough to prevent (Please turn to page 562)



The Builder

The power that placed the monster stones of the Pyramids is still open for debate; but who questions that wire rope is the great Builder of today?

Much of the wire rope used in construction is Yellow Strand, that famous brand with *one strand of yellow*. Made in St. Louis and Seattle by a pioneer in the wire rope manufacture, the supreme quality of this kind of ropes is recognized throughout the Western Hemisphere and in many countries across the "great waters."

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of the Bell System to use in serving the public. The results of the efforts are evident, not only in the extension of telephone service across the Atlantic, but in the constantly improving local and long distance service at home.

The very nature of the telephone business necessitates a single interconnected system. The American Telephone and Telegraph Company accepts its responsibility for a nation-wide telephone service as a public trust.

It is fundamental in the policy of the Company that all earnings after regular dividends and a surplus for financial security be used to give more and better service to the public.

Learning to Use Our Wings

(Continued from page 548)

It is quite possible that airships of this type may have a future as a new kind of air-yachts. The record of the *Puritan* from August 6 of this year to September 15, was a series of flights on 83 days out of 45, covering 5685 miles and carrying 450



The *Pilgrim* taking off from the roof of a department store in Akron, Ohio, where it had previously landed with comparative ease. Other picture on page 548

passengers, which is highly creditable. An objection to airships has been so far in the difficulties of handling. An interesting and new development in this regard is the use of a motor car specially equipped for airship service. A feature of this motorized machine shop is a portable mooring mast to assist in landing.

Elements of Aviation

COLONEL V. E. CLARK is a rare combination of pilot, airplane designer and aerodynamicist, and his recently published book "Elements of Aviation" (Roland Press, New York City) gives proof of his breadth of view. The author knows aerodynamics, but presents the subject not as an abstract science but as a real introduction to the study of airplane design. The treatment is remarkably clear, and mathematical expressions are reduced to a minimum.

The author modestly disclaims original thought in his treatise, but his methods of presentation are both original and striking. Even an experienced designer will find much to interest him in this elementary book.

Throughout the book we find apt definitions and illustrations. We shall look forward to the companion volume on design which is to follow.

Aerial Advertising

THE industrial applications of the airplane constantly are being increased. While sky writing has apparently suffered a temporary eclipse, aerial advertising at night is to be undertaken vigorously by Aerial Advertising, Inc., a New York City company.

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Judge Simmons world-famed psychologist, jurist, author and teacher. Judge Simmons has set forth the fundamental working principles of Christian Psychology in a wonderful lecture entitled "The Kingdom of God." This lecture will be

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A huge biplane, built by the Keystone Aircraft Corporation, with the lower wing of 15 feet greater span than the upper one, so that its total spread is 90 feet, is being equipped with an illuminated sign, 90 feet in length and six feet, six inches in width. Small strips of bass wood, measuring two and a half inches in width are mounted on the underside of the lower wing. The illuminated letters of the advertising sign are secured to these strips.

Six wind-driven electric generators mounted on the wing provide the current for the sign. For extra reliability there are two independent lighting circuits. The tests made on Long Island have shown that these signs can easily be read from an altitude of 8000 feet.

Inventions Needed for Safety

WHILE aviation safety is not solely a matter of invention, depending as much on training of personnel, ground organization, et cetera, still many inventions are needed. We can only list a few typical suggestions.

In the structure of the airplane, there is inevitable vibration due to the engine, which cannot be avoided, particularly when only a few cylinders are employed. Perhaps it may be possible to avoid the transmission of vibration from the engine to the rest of the plane, by the employment of rubber as a shock absorber between the engine mount and the rest of the plane.

Radio, lighting, and weather service as aids to navigation, are progressing rapidly. We have still to see a dependable altimeter which will warn the pilot of dangerous proximity to the ground in case of fog. A field localizer which will guide the pilot to the center of a field still remains to be made practical. The danger of collision will increase as the number of planes aloft increases, and some form of collision signal is needed. Television through the fog has been often suggested.

In the aerodynamic design of the plane, as we have often discussed, there is need of devices which will decrease its landing speed without affecting other desirable characteristics.

In the prevention of fire, the production of a light weight engine on the Diesel or semi-Diesel principle, burning heavy, non-inflammable fuel, will be a great boon.

There are many opportunities for engineers and inventors.

Popularizing the Science of Flight

THE properties of the wheel, the pulley, the lever are instinctive with us through many generations of use. While the air is all pervading, it is invisible and very much of a mystery. The science of aerodynamics or air flow as applied to the airplane therefore needs popularization, and a number of authors have undertaken to write simple accounts of the theory and construction of the airplane. Such works will do a great deal of good to the cause of aviation.

They are very much harder to write than technical treatises in which mathematical language can be freely used. We have recently received an excellent book of this type, "The ABC of Flight" by W. Laurence Le Page, published by John Wiley and Sons. In simple language with clear diagrams Mr. Le Page explains the fundamental principles of flight, how stability and control are achieved, how an airplane is built, and the elements of flying instruction.

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Industries From Atoms

(Continued from page 545)

Atchison, Topeka, and Santa Fe Railway during the last 15 years is of convincing interest.

In October, 1913, a number of southern pine fence posts were placed along the right of way at Cleveland, Texas, to obtain information on the relative life of untreated posts, posts treated with the standard preservatives—zinc chloride and coal-tar creosote—and those treated by various other methods and with materials claimed to possess preservative properties. These posts were inspected three, six, seven, eight, 11 and 14 years after being placed in service.

A summary of these records indicates the comparative value of thorough treatment and brush treatment and of standard preservatives and non-standard materials. The untreated posts were decayed three years later. Brush treated posts and those treated with various non-standard materials were decayed in three years and removed at various periods after seven years, the few standing at the end of 13 years being held up only by some heartwood still remaining. Posts, pressure-treated with coal-tar creosote and with 1.28 pounds of zinc chloride per cubic foot, were in excellent condition without signs of decay, after 14 years of service. Only one of the posts treated with the light absorption of 0.417 pounds of zinc chloride per cubic foot showed decay after 11 years' service.

Faith in Research Leads Firm on Unique Path to Profits

FROM the manufacture of baking powder to the production of sheet metal seems like a long step for a manufacturer to take but such was the perfectly logical step taken by the R. Hardesty Manufacturing Company of Denver, Colorado, as a result of their confidence in the economic value of chemical research.

The Hardesty Company made baking powder and flavoring extracts in Denver. Their baking powder cans were shipped to them from eastern manufacturers. Their research men pointed out that it would be quite feasible for the company to make its own cans and accordingly a plant was started. Eventually the demand for cans in the western district became so large that the company found it advisable to drop its original line entirely and devote itself exclusively to the production of containers.

The research men were still on the job and advised the extension of the company's line to include sheet iron irrigation flumes to replace the wooden flumes long used by the Colorado farmers. Then came the sheet metal road culvert at first called impractical. The research men made it practical. Tanks, valves, metal drums, street signs, measuring weirs, and many other products have been added, each after an investigation of the technical possibility as well as of the market situation. Thus for nearly 40 years an industrial concern, far from the manufacturing centers, has kept busy and growing and today is still searching for new things to make to keep its facilities busy.

Science Seeks Safer Safes

SAFER safes is the goal of a regular program of scientific study at the United States Bureau of Standards. Additions to the safe-testing equipment of the

bureau have been recently completed. With them, loads can be applied to the safes before, during or after the fire test. Such load application will be made to determine the degree of strength and rigidity of safe structure required to preserve the proper alignment of door and jambs under ordinary conditions of use. Loads can also be applied to safes by methods that will give information on resistance to such impacts as safes receive from failure to building walls and floors in fires.

The equipment has been further supplemented with a conditioning chamber that can be equipped for conditioning safes under given temperature and humidity conditions. The amount of water, free and



Although experiments in chemical laboratories subject concrete to all sorts of tests, it remained for a fire in Fall River, Massachusetts to produce this eloquent testimony of the fire-proof qualities of a concrete vault. This safe in the Troy Co-operative Bank preserved all its contents, while steel filing cabinets were ruined

combined, that the insulation of a safe will permanently retain determines to a considerable extent the effectiveness of the safe in preserving its contents from fire after a long period of use. Some manufacturers subject the safes after filling, or the filling itself, to a drying process to drive off excess moisture. In fire-endurance tests of safes conducted soon after they have been filled, the weight losses from water evaporation generally range from 15 to 80 percent of the weight of the insulation, or a water loss for the larger safes of from 800 to 600 pounds, equivalent approximately to 85 to 70 gallons.

New Tricks With the Carbonyl Radicle

THE chemist can never guess into what fields his researches will lead him. A. Mittasch, one of the distinguished experts of the German dye trust, has discovered a new anti-knock compound, a photographic chemical, and a remarkable new kind of iron, all as a result of his study of the



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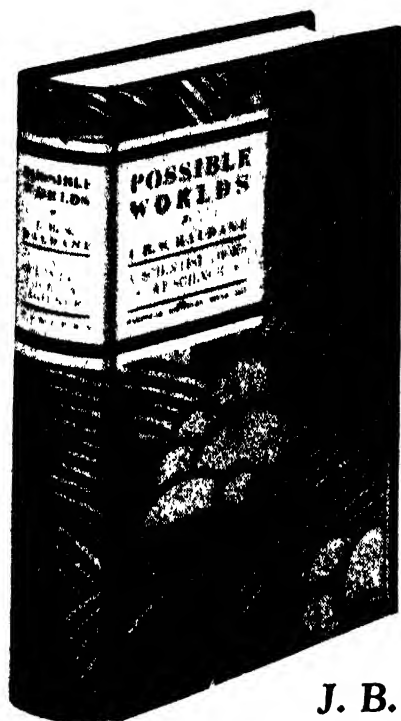
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Those Versatile X-rays

There was an old maid from Duluth,
Who, when she had left but one tooth,
Made her living with ease
Biting holes in Swiss cheese.
Now wasn't she cunning, forsooth?

Stop me if you've heard that one, but it just would perpetrate itself as a preface to



At the University of Illinois, apparatus for research in the behavior of gases at high pressures has been developed in order to study the new methods of producing methanol (wood alcohol) from water gas. This photograph shows the catalyst chamber where methanol is produced by means of a mixture of carbon monoxide with hydrogen gases

this latest application of the X ray to the examination of the size and location of desired holes in that excellent comestible. In addition to that, Dr. George L. Clark in a recent issue of the *Catalyst* reminds us of other new marvels of the X ray as follows:

"The physicists have used them to explore the inner structure of atoms and the chemists have discovered new elements with the aid of X-ray spectrographs.

"There are three general types of X-ray examination; one deals with the gross structure of objects as shown by radiographs; second, the fine structure of matter as deduced from the characteristic X ray diffraction patterns produced by the substance under examination; and third, the spectrographic study of materials used as targets in X-ray tubes. A few typical illustrations of the numerous practical

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uses of X rays in determining gross structure include the determination of the symmetry of golf-ball centers, the adhesion of rubber to cords in tires, inspection of reclaimed rubber for nails and foreign matter, examination of insulated wire, the inspection for worm holes, knots and cracks, of wood used in airplanes, inspection of walls for hidden wires and pipes, examination of old paintings for retouching and for superposed pictures."

The examination of the fine structure of materials has been most fruitful in producing invaluable fundamental information. In 1912, Lane made the brilliant discovery that an ordinary crystal will diffract X-rays in a manner similar to that in which a diffraction grating diffracts the visible light rays. So remarkable has been the development of this discovery that today we know more about the solid state of matter than either the liquid or gaseous states. These studies have divulged the arrangement and number of atoms in the ultimate crystal of many metals, alloys, and inorganic and organic compounds.

Improved equipment has made it possible to examine crystalline organic compounds as well as metals and heavy elements. Hence today X rays are being utilized in efforts to interpret stereoisomerism, optical activity, and other properties of organic substances. Mixed crystals as found in paraffin waxes have been examined and the diffraction pattern obtained was apparently that of one hydrocarbon.

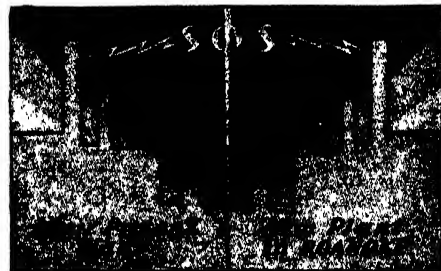
Colloidal and amorphous substances have been investigated more recently. Rubber, when stretched, has shown a crystalline fiber diffraction pattern. Cellulose has proven to be crystalline (rhombic) and to have the composition $(C_6H_{10}O_5)_n$. Amorphous substances may exhibit patterns made up of 2 or 3 diffuse diffraction rings which appear to indicate the distance of nearest approach of the molecules in the materials. The industrial applications of X rays are almost countless.

Measuring the Temperature of Flames

FLAMES produced by the combustion of gases and vapors are used in many industrial operations; they cook our food, heat our houses, and even furnish motive power for our automobiles. The efficiency of flames in doing their work is often related closely to their temperature, but up to the present time there have been few actual measurements of the temperature of such flames.

The flame laboratory of the Pittsburgh Experiment Station of the United States Bureau of Mines is making direct measurements of the temperature of flames in connection with a study of the physics and chemistry of combustion and explosion. It has been found that the brightness of a flame colored yellow with sodium chloride vapor is directly proportional to the flame temperature, and in the method employed at the Bureau of Mines laboratory the intensity of this light is compared in a spectroscope with light from a tungsten band heated to a known temperature. Measurements have been made on flames of natural gas, methane, propane, and carbon monoxide and the work is being extended to include all the commonly used gases and vapors, mixed both with air and with oxygen, and in different types of burners.

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The Back Yard Astronomer

(Continued from page 555)

blurring of the image due to the motion of the Moon when the telescope is not equipped with clock drive.

"The enclosed pictures of the Moon were made with a six inch mirror and an eyepiece of about $\frac{3}{4}$ inch focal length. I believe I can make better ones, but these will give a fair idea of what one can do with a six-inch mirror." (One of these is reproduced in "Amateur Telescope Making."—Ed).

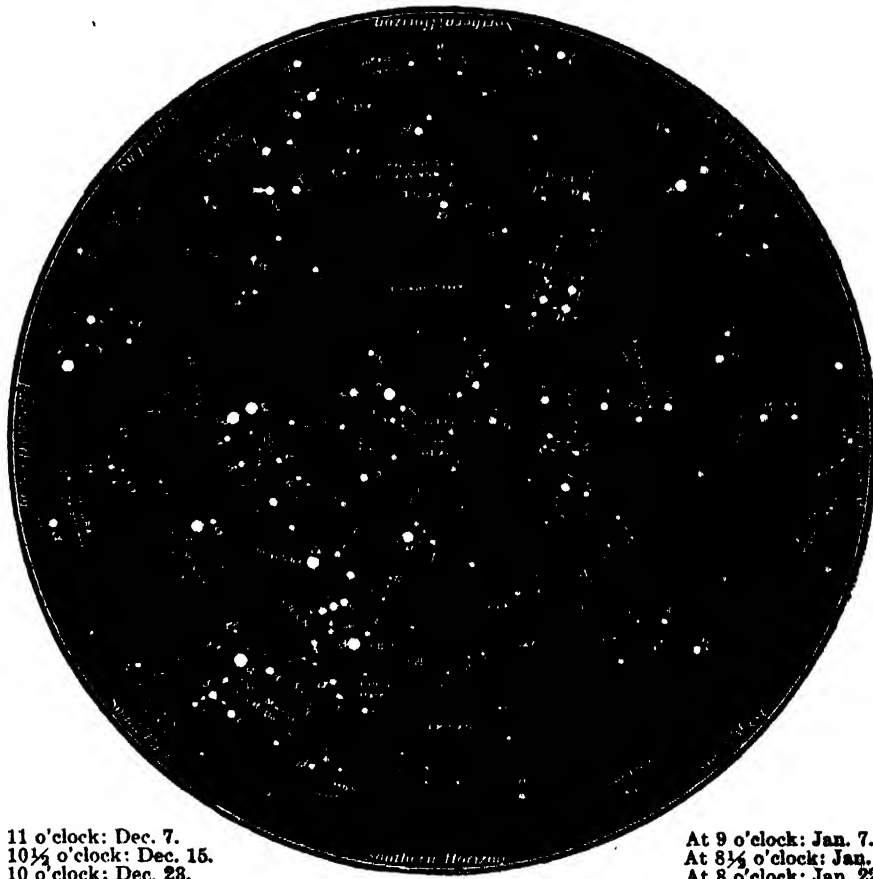
"An ordinary negative eyepiece works all right, but an achromatic eyepiece would probably be better with high magnification."

J. M. de Jager, Embong Kenongo 33, Soerabaja, Java, Dutch East Indies, sent us rather long ago a photograph showing progress on a six-inch mirror. It is a long way from America to Java but we have records of amateurs making telescopes in many other distant lands and we here urge them to send us photographs and descriptions of their telescopes. Says Mr. de Jager:

"In my last letter to you I promised to write to you about my progress while making the mirror of my future telescope. As I have only a little spare time, I progress very slowly. I send you the photograph. You can see that I am working temporarily in the open air."—A. G. I., Tel. Ed.

The Heavens in December

By PROF. HENRY NORRIS RUSSELL, Ph.D.



At 11 o'clock: Dec. 7.
At 10½ o'clock: Dec. 15.
At 10 o'clock: Dec. 23.

At 9 o'clock: Jan. 7.
At 8½ o'clock: Jan. 14.
At 8 o'clock: Jan. 22.

At 9½ o'clock: December 30.

NIGHT SKY: DECEMBER AND JANUARY

MERCURY is in conjunction with the Sun on the 18th, and is practically invisible this month. Venus is an evening star and is growing more conspicuous as she comes north. At the end of the year she remains above the horizon until after 8 P. M. and is very prominent.

Mars is in opposition to the Sun on the 21st; he is in the western part of Gemini and about as far north of the celestial equator as he ever can get, reaching the high declination of $26^{\circ} 47'$ at the end of the month. This adds to his prominence but he is in the part of his orbit which lies farthest from the Sun and is therefore not as near the Earth as he was in 1924 or 1926. His nearest approach, which comes on December 16, leaves him at a distance of 55,000,000 miles. He therefore appears smaller in the telescope and fainter to the eye than in recent years; even so, he is a fine object—almost as bright as Sirius.

Jupiter is in Aries and may be seen in the south about 8 P. M. Saturn is in conjunction with the Sun on the 18th and cannot be observed. Uranus is in eastern quadrature on the 25th, and is on the meridian at 6 P. M. Neptune is observable telescopically in the early morning.

The Moon is in her last quarter at 9 P. M. on the 3rd; new just after midnight on the 12th; in her first quarter at 10 P. M. on the 19th, and full at 8 P. M. on the 26th. She is nearest the Earth on the 26th and farthest away on the 11th. As she makes her circuit of the heavens she passes Neptune on the 2nd, Mercury on the 11th, Saturn on the 12th, Venus on the 18th, Uranus on the 20th, Jupiter on the 22nd, Mars on the 26th, and Neptune for the second time on the 30th.

At 10:04 P. M. on December 21, the Sun reaches the southernmost point of his track and "winter begins."

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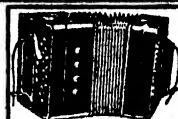
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The Scientific American Digest

(Continued from page 543)

being placed directly under the hopper of the car. As the material falls down on the device a wide rubber-covered belt carries it away to a point for unloading into trucks or upon a pile from which another conveyor may take it for storage or delivery. The belt of the unloader is operated by means of an electric motor or a gasoline engine, and as this means of power is detachable, the device may be easily handled by one or two men. Depending upon the nature of the material unloaded, the machine can easily handle from one to three tons per minute.

Skyscraper Endurance

IN a recent issue of SCIENTIFIC AMERICAN, there appeared an editorial entitled "Will Skyscrapers Endure?" This editorial was based upon an alleged interview with Sir Edwin Lutyens the eminent British Architect, who is said to have commented on the condition of the steel work in the recently demolished old Madison Square Garden. He is said to have criticized steel construction.

The American Institute of Steel Construction, Inc., calls our attention to the fact that when the account of this alleged interview first appeared in America, they telegraphed Sir Edwin asking the basis of his reported statement. He cabled in return that the statement was not authorized by him.

The Institute in commenting further, stated: "SCIENTIFIC AMERICAN has plenty of authority for the position it has taken in the editorial insofar as the engineering problems are concerned, and you are fully justified in defending the American skyscraper and the building practices followed in the United States."

We regret that we have given further circulation to this report which turns out to be baseless.

Man Became Erect-Postured From Pulling at Branches

MAN owes his present proudly erect position to a long line of tree-dwelling ancestors. Brachiation — which means pulling one's self about among the branches — is the only way in which the spinal column could have gained an upright position, declared Dr. William K. Gregory of the American Museum of Natural History, speaking in Philadelphia recently before the meeting of the American Philosophical Society. A series of the upper arm bones of primitive mammals, lemurs, monkeys, and apes, shows increasing resemblance to the corresponding bone in the human arm, he stated, and there are many further details of structure, especially in the hand and foot of man, that indicate a former tree-dwelling mode of life.—Science Service.

Food for the Fish

DO bugs, millers, moths, flies, beetles, and all the other insects have any preference as to the color of the light around which they like to swarm and swirl on warm summer evenings? No, says the Izaak Walton League of Fort Wayne, Indiana, which has combined business with pleasure in the installation of floodlights of various hues around the lagoons in Lakeside Park there.

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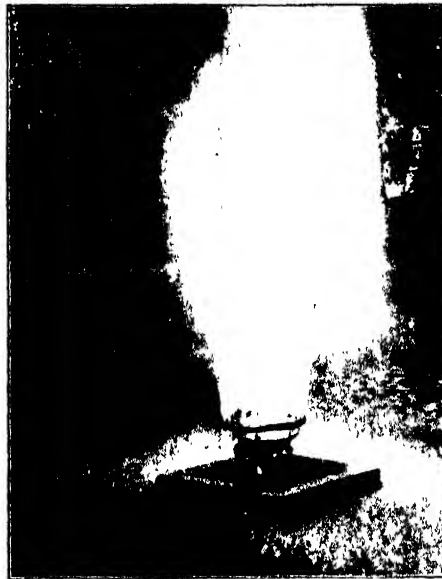


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Visitors to the park might, with reason, be led to believe that the colored floodlights had been installed to add to the natural beauty of the park, but there is more to the story. The underlying motive for the lights is that in the five lagoons of the lake are fish of many kinds and sizes, for the lake is used as a hatchery by the disciples of Izaak. Fish must be fed, and they prefer insects. But a hatchery, with its concentrated population, needs an extra abundance of insects above



The waterproof light under this fountain attracts insects at night and the spray throws them into the water as food for the fishes

and in the water if all the finny denizens are to have their appetites appeased. And hence the lights to lure the insects to their destruction.

Some might think that enough had been done for the fish by the installation of the lights. Plenty of the flyers would circle the lights until tired, and then drop into the lake or even directly into the gaping jaws of the waiting fish—and enough of them would also fly low enough so that the more lively fish could obtain their food by quick jumps into the air.

But no unnecessary or undesired exertion for Fort Wayne fish, says the league. If the fish would rather wait and have their dinners served, it can be arranged. Hence the installation of sprays, not to wash off the bugs, but to wash them into the lake. And the sprays serve still another purpose, for they aerate the water—to say nothing of the fact that the beauty of the lake is further enhanced by them.

Operation of the fish hatchery is conducted jointly by the city park board and the local chapter of the Izaak Walton League. The bug-catcher installation includes five General Electric submarine-type floodlights, equipped with different colored glass fronts, installed within ring sprays.

Pineapple Water Tank

REARING its 30-ton bulk 195 feet into the air, a giant water tank stands atop the new 500,000 dollar office and warehouse building of the Hawaiian Pineapple Company at Iwilei, Hawaii. It has been shaped and painted to represent a ripe pineapple, even to the green steel "leaves" of the crown. It will serve as a

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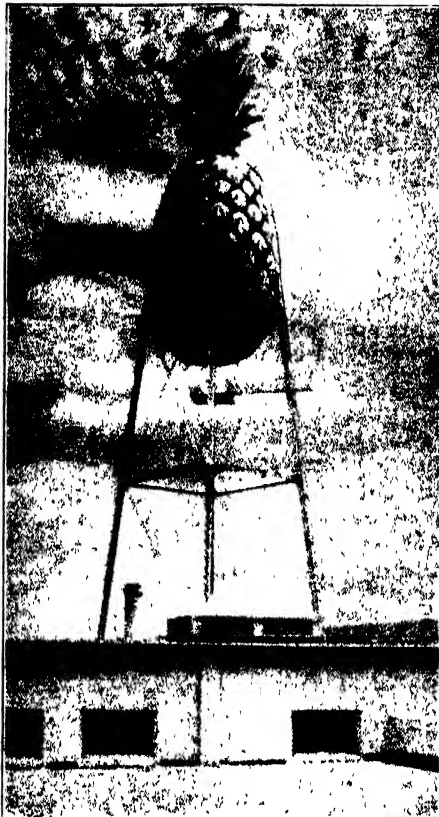
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water tank to provide fire protection not only for the company's plant but for that of the American Can Company which is nearby, and as a beacon to aid ships entering Honolulu Harbor. It will have a water capacity of 100,000 gallons.

The completed "pine" is lighted all night by flood lights. Lights come from three sources, with two searchlights at each point. Each light has a capacity of 1000 watts, although at present only



The water tank on a building of the Hawaiian Pineapple Company. It serves as fire-protection and as a beacon for harbor navigators

750 watts are installed in each. The supporting tower is painted so that, when the tank is lighted, only the tank will be visible, the effect being that of a giant pineapple suspended in the sky.

New Camera Films Give Correct Color Values

AMATEUR photographers with roll film cameras can now take pictures of colored objects in which light red objects appear light, while a dark blue photograph dark. A large film manufacturing concern in London, England, is now producing "panchromatic" roll films. These do not take pictures in natural colors, but they do reproduce color values correctly. With ordinary films, red photographs black or very dark, while blues appear very light.

Panchromatic plates have been on the market for some years, while similar film has been made for use in movie cameras. However, it has never been obtainable before for roll film cameras, which are most commonly used. The film is not very much more expensive than the ordinary kind. As the films are sensitive to red light, they cannot be developed with the ordinary red dark-room lamp. The film manufacturers, however, will develop them.

—Science Service.

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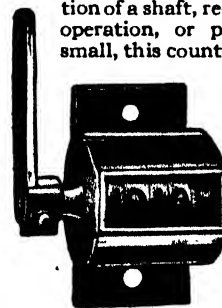
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A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

The Flying Paster

INTO one end of a mammoth printing press a roll of plain paper is being fed. Out from the other end drops, faster than you can count, copy after copy of a 64-page newspaper, completely printed and folded. The roll of paper is about exhausted. Paste is placed on the outside of the loose end, the press is slowed down a bit, a motor-rotated reel brings up a new roll in contact with the old, and the press speeds up again. The old expired roll is removed from the reel and a full roll put in place.

This joining of the old and new rolls is a practice termed "a flying paster," and permits a continuous feeding of paper to the press without stopping the press to change from one roll to another. In newspaper printing, where every saving of a moment's time is of the greatest importance, its achievement is of great value. How valuable it may be to the holder of the patent is evidenced by the fact that in five years he made installations in large newspaper offices for an aggregate price of 1,300,000 dollars.

The inventor, Irving Stone, applied for his patent in 1900, but it was not issued until 1915. Before that time he had assigned his rights to one Kohler. Only in 1919 did it begin to be adopted widely and rapidly. In that year the Cline Manu-

findings are illuminating on the question of prior public use.

The Cline and Westinghouse companies contended that the patent was invalid on the ground that the device was used more than two years before the date the patent was applied for. They showed that Stone, who was mechanical superintendent for the Chicago News, had installed there a multi-reel feeding device for two new presses. Soon thereafter, it was shown, the pressmen became so expert that they could cut out the expiring roll and paste the severed web to the new roll, thus continuing the operation of the press by very materially slowing it down, but not stopping it. This was in a sense a flying paster, manually made. The testimony of witnesses as to their recollection of the exact method of operation in 1897 was more or less contradictory.

"It is quite elementary," says Judge Alschuler, "that to strike down a patent upon the ground that the patented article was in public use more than two years before the application was filed, this fact must be established by evidence so clear as to satisfy beyond reasonable doubt; and the evidence must so satisfy not alone as to the time, but also that the use was of the very thing which was patented."

That the inventor and the assignee appreciated the value of their patent is

file wrapper, which shows a pendency of 14½ years, without as much as an interference proceeding to consume the time. Applicant made 12 amendments, in each instance delaying within a week of a full year following the next proceeding action of the Patent Office. But this being within the law as it then was, the validity of the patent is not thereby affected."

Stopping Leaks in Radiators

HOW many a "tin can tourist," finding a leak in the radiator of his car, has gone into a drug store, bought some flaxseed, dumped it into the water in the radiator and then forgotten about it? Or maybe he used rice flour, oatmeal, sugar, flake asbestos, or graphite. They also would stop such a leak just as well.

Louis J. Stern, of Boston, however, saw possibilities in such a method of stopping a radiator leak. On October 15th, 1918, he obtained a patent on a method of stopping leaks in metal vessels which "involves the employment of a leak stopping ingredient which with water is adapted to form a colloidal solution." In his patent Stern stated that the essential constituent of the composition is a substance commercially known as cube gambier, which is an extract from certain trees or shrubs and contains catechin and tannin, although some other bark extracts may be employed.

It was no great time before the leak stopping compound was on the market in half-pint cans at six dollars each. The inventor's assignee, E. R. Tolfree, was making it in his plant known as X Laboratories, and selling it at that price. And S. G. Wetzler, of the Blue Seal Chemical Company, began to make it too. The usefulness of the solution is evidenced by the large public buying at the high price. It was used on most of the long distance airplane flights beginning with the NC-4 transatlantic flight in 1919, and including the McMillan Arctic expedition of 1925.

Tolfree sued Wetzler for infringement. He lost in the Federal District Court in New Jersey, but took the case up to the Circuit Court of Appeals. There the lower court was reversed, the patent was declared valid and Wetzler was ordered to make a complete accounting. Judge Buffington said:

"The results in metal leak stopping by this fluid solution present a case of an unusual kind and we are satisfied the contribution of this patentee to the art was one so effective, unlooked for and simple as to brand it unusual in character.

"Moreover, the disclosure was original and novel. Gambier had been used for years in the tanning art and in other ways; its qualities were known. But no one before Stern conceived the idea of using gambier in suspension in water where the solution would remain fluid until a leak occurred.

"The use of gambier for such purposes, its continuing in suspension in water, its



The fact that "knocking down" by conductors on street cars and buses in the United States amounts to 40,000,000 dollars a year, has provided John F. Ohmer with an opportunity for invention. His device not only records the fare, but prints a ticket stating the points between which the passenger is traveling. It may eliminate the selling of tickets in stations



facturing Company, in conjunction with the Westinghouse Company, installed press-feeding machinery embodying the Stone invention in the plant of the Chicago Tribune, undertaking to protect the Tribune against all claims for infringement. Kohler sued the Cline and Westinghouse companies and at last obtained a decree from the Federal District Court for the Northern District of Illinois, holding the patent valid and infringed. The case was appealed and now Judge Alschuler has written the opinion for the Circuit Court of Appeals. His

evidenced by the long time they kept it pending, for the purpose, apparently, of putting off the date of expiration as late as possible. It is a costly process and sometimes a dangerous one, but it is wholly within the law. On this point Judge Alschuler says:

"The defense of invalidity urged in the District Court, based on delay in prosecution of the application for the patent, is not seriously urged here. That the prosecution was most extraordinarily precastigated is manifest from inspection of the

faculty of not clogging the channel, its solidifying when escaping through the leak, all matters elemental in this method and use of colloidal state, made a combination so unusual, unexpected, novel and useful as to place it in the zone of invention."

Judge Davis was not impressed by such reasoning. In a dissenting opinion he said:

"The evidence, as a whole, amounts to this: Gambier used as a composition by an old method, well known in the prior art, to stop leaks in metal vessels, such as automobile radiators, is 'superior' to other compositions used in the same way. Such use of gambier in my opinion does not constitute a valid method patent. I think the decree of the District Court should be affirmed, and so I am constrained to dissent from the majority opinion of the court."

Mortgages and Admiralty Liens

WHEN is a boat not a boat?

About the answer to that question recently revolved a 300,000 dollar mortgage foreclosure suit. The Federal District Court for Southern Florida answered one way, and the Circuit Court of Appeals for the Fifth Circuit in exactly the opposite way. Here are the facts.

The Shoreland Company, a Florida Corporation, owned a tract of land on Biscayne Bay and was engaged in filling it by pumping sand and other material from the bottom of the bay. For this work it acquired the steam suction dredges *Lawrence* and *Massachusetts*. In October, 1926, Robert McArdle filed libels against both dredges, claiming maritime liens for supplies, equipment, labor, and money advanced. A number of other parties filed similar liens. The J. C. Penney Corporation held a mortgage for 300,000 dollars covering both dredges. In October, 1927, a decree was entered allowing the claims as maritime liens and allowing also the claim of the J. C. Penney Corporation under its mortgage, subordinating it to the maritime liens. The dredges were sold and the money deposited in court. The maritime claims absorbed the entire proceeds. The holder of the mortgage apparently was out of luck; it took an appeal.

The whole case hinged on whether the dredge boats were boats, and, therefore, subject to admiralty law. If so, the claims of the maritime supply men should be satisfied first; if not, the mortgagee was entitled to its share. Judge Foster, writing the opinion of the Circuit Court of Appeals, straightened it out as follows:

"There is no doubt that a dredge boat engaged in navigation, or in doing work for the purpose of improving a channel, or that will be an aid to navigation, in certain circumstances, is subject to admiralty jurisdiction, but a distinction is made where a vessel or other floating structure is not so engaged. It is essential that in order to maintain an admiralty lien on a vessel for supplies or advances, that she be at the time engaged in a maritime venture. It is clear that such is not the case here.

"Of course, the dredging deepened the water where the material was removed but that was merely incidental to the work being done. The dredges were not engaged in either commerce or navigation. The purpose of employing them was to make improvements on land, not for the purpose of aiding maritime commerce, but to fill up the land, in order to bring it to the required grade, for the purpose of sale. The prin-

ciple underlying maritime liens is that the supplies furnished are intended to benefit the ship and not the owner. No maritime liens were created on the dredges for any of the supplies, or advances shown to have been made."

Chile's New Regulations

THE Chilean government recently has promulgated a new regulation settling some questions which have caused considerable controversy in trademark registration. Among the changes is a new interpretation of the right to register.

Heretofore anyone could register a trademark, provided it had not previously been registered and it did not fall within certain specific exceptions. Ownership of the mark was conceded automatically to the registrant.

Under the new interpretation, the Trademark Office will undertake an investigation to ascertain whether the person applying is the manufacturer or the dealer in the article, or is the owner of the establishment which the mark signifies, or whether the mark has not been registered or in use within the country for a period of at least one year. Publication will be made of applications at least 30 days prior to acceptance of registration, and owners of marks may contest the application, provided they can prove prior ownership and use within the country for at least a year.

If the trademark has been in use for more than a year by two or more persons, the registrant must permit the others to continue using that mark. Certain defi-

nitions also are given as to what constitutes graphic or phonetic similarity which would prevent registration.

Our Changing Trademark Law

TIME was when the rules governing ownership of trademarks were simple ones. A man could not extend his mark beyond the class of goods he sold. Another might use the same trademark for dissimilar articles and the first user would not be heard to protest. What harm would it do a piano manufacturer, the courts reasoned, to have a hosiery mill use the same trademark? One could never by any stretch of the imagination divert sales from the other.

That there is a change in the attitude of courts, however, is indicated by the successful effort made by the Yale and Towne Manufacturing Company to prevent the Yale Electric Corporation from registering the notation "Yale" for flashlights and batteries. Yale and Towne make locks.

"It has of recent years been recognized," declare Judges Learned Hand, Swan and A. N. Hand in the Circuit Court of Appeals for the Second Circuit, "that a merchant may have a sufficient economic interest in the use of his mark outside the field of his own exploitation to justify interposition by a court. His mark is his authentic seal; by it he vouches for the goods which bear it; it carries his name for good or ill. If another uses it, he borrows the owner's reputation, whose quality no longer lies within his own control. This is an injury

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Apparel

CORSET—A one-piece knit seamless and shaped combination corset and brassiere, which will act as a reducer, and has an upper curved portion at the front. Patent 1683510. O. C. Wiesse, c/o Leon Rubenstein, Security Mills, Inc., Newton, Mass.

Pertaining to Aeronautics

AIRCRAFT—Having means whereby the ends of the planes or wings may be projected during the take-off, or during landing, and can be drawn inwardly at the will of the operator during flight. Patent 1685014. A. A. Anderson, 80 W. 40th St., New York, N. Y.

Chemical Processes

CENTRIFUGAL LIQUID CRUCIBLE—Comprising a vessel provided with a refractory lining and adapted to contain molten metal to form a crucible, an electrical conductor embedded in the lining, and means for rotating the vessel. Patent 1684800. J. Maximoff and M. S. deCosta, c/o C. Chassevent, 11 Boulevard de Magenta, Paris, France.

Designs

DESIGN FOR A PINCUSHION—Patent 76237. Ellen L. Harrison, 847 Lexington Ave., New York, N. Y.

DESIGN FOR A WEATHER VANE—Patent 76316. E. W. Lawson, 509 "O" St., West Palm Beach, Fla.

Electrical Devices

RADIANT-HEATER ATTACHMENT—By which the heat generated is circulated by thermal action through the interior and against the exterior of the attachment thus increasing the heating efficiency. Patent 1682038. G. L. Davenport, Jr., 1430 W. 52nd St., Los Angeles, Calif.

RADIO RECEIVING CIRCUIT—The object of which is to overcome objectionable radio frequency oscillations originated either in the receiver itself, or imposed upon the receiver by external impulses. Patent 1685043. J. M. Cartwright, Helena, Ark.

RHEOSTAT—Of the grid type having a supplementary or auxiliary grid by the particular use of which alternating current may be adapted to welding purposes. Patent 1685714. T. E. Moorer, Summerville, S. C.

ATTACHABLE SHOWER—Which may be readily secured to a bath tub without the assistance of a plumber, will guide the water into the tub, and prevent splashing the floor. Patent 1685180. J. C. Sheller, 410 St. Charles Rd., Maywood, Ill.

SCARIFIER TOOTH—So constructed as to permit of reversal in its shank, thereby presenting a fresh point for engaging the road or other surface to be worked. Patent 1685198. C. E. Gilbert, c/o Gilbert Mfg. Co., Stillwater, Minn.

even though the borrower does not tarnish it, or divert any sales by its use, for a reputation, like a face, is the symbol of its possessor and creator, and another can use it only as a mask. And so it has come to be recognized that unless the borrower's use is so foreign to the owner's as to insure against any identification of the two, it is unlawful."

Patents for Color Sequences

AN interesting example of the distinction between what is patentable and what is not, is provided by a recent decision of the Board of Appeals of the Patent Office allowing some of the claims in a patent application by Charles Stolp, Jr., and rejecting others. Some of Stolp's claims were for a roof of such a color arrangement that a distinctive pattern was avoided. These were held to be unpatentable, since they were for the production of an ornamental effect and did not come within any of the statutory clauses of invention.

On the other hand, claims were allowed which were directed to a package of colored shingles so arranged, that the builder can take them in the order in which they are packed and produce the color effect desired on the roof.

The Board says:

"In our opinion, anyone should be free to use his own judgment as to the obtaining of a proper effect, and we do not see that the use of a larger number of shingles of the predominant color, a smaller number of a harmonious shade and a still smaller number of contrasting color of itself would produce the result which in the end must come from the judicious distribution of these shingles on the roof.

"Claims 5 to 11 inclusive, cover a package of shingles of different color which are so arranged in the package, that when laid in regular order on the roof, the desired effect will be produced without requiring any special care on the part of the workmen.

"We do not think that the package of playing cards cited by the Examiner, would suggest this invention, and we believe there is sufficient merit in these claims to justify their allowance."

Steel Wool to Catch Soot

THERE are two ways in which an inventor might start to work. He might take an article and seek out a way to use it, or he might see a need for some article to perform a certain function and then seek for such an article. In either case, the inventor is beginning with a solid foundation; his measure of success depends upon how practical he is.

Using one of these situations as a basis, Maxemilean Koehler made an invention. He recognized that greasy soot arises from a kitchen range oven and fouls the kitchen walls and hangings. Others, attempting to remove the soot and grease from heated gases have tried asbestos fiber and other filters, but they have been unsuccessful because the filtering material quickly became foul. Koehler conceived the idea of using "mineral wool, asbestos, hair, or the like" as a filtering medium. He obtained a patent. This was not entirely satisfactory, however, and he kept working away at the problem until he hit upon steel wool. By passing the fumes from the oven through a flue having a filter mat of steel wool, he found that the soot and grease

Of Interest to Farmers

CULTIVATOR—Of the sulky type, especially adapted for cultivating corn, will efficiently destroy weeds, and will not become clogged when the soil is wet. Patent 1683008. R. Aarvig, c/o John H. Bruninga, 1706 Railway Exchange Bldg., St. Louis, Mo.

AUTOMATIC POULTRY FEEDER—In which a supply of feed is released and distributed at any predetermined hour, the release being accompanied by an alarm to arouse the poultry, and illuminating means. Patent 1684334. R. F. Toope, Box 959, New Haven, Conn.

HONEY RICK—For use in bee-hive supers, in which honey deposited by the bees automatically drains into a container, which may be readily drained and replaced in the super. Patent 1685021. S. G. Broyles, Battle Mountain, Nevada.

Of General Interest

COMPACT-PLATE-FOLDING RING—For holding a compact and its supporting plate in a vanity case, the ring holder interlocking with the case, yet permitting easy removal. Patent 1683552. W. G. Kendall, 118 Market St., Newark, N. J.

SCRUBBING MOP—Which may be subjected to heavy wear, the yarn of which will automatically spread and rapidly dry, when the mop is inverted after use. Patent 1683549. E. P. Jones, 228 E. Washington St., Pulaski, Tenn.

RECLINING COUCH—In which the head section may be manually moved to the desired angle and securely held in adjustment, the device is also applicable to a chair back. Patent 1683513. T. Wolf, 251 Central Ave., Union City, N. J.

WEATHER STRIP—Including a base and a flexible element adapted to be applied to a door jamb or sill, to engage the side edge, or bottom surface of the door. Patent 1683564. A. Miller, 70 Greenwood Ave., East Orange, N. J.

ROPE CLIP—Including U-bolt clamps for bending or cramping rope, for rope end loops and splices, the U-bolt clamps having upstanding centrally there between a spreading stud. Patent 1683512. H. Wisbauer, c/o Penn Alto Hotel, Altoona, Penn.

HAIR WAVING OUTFIT—A structure capable of winding the hair from a point close to the scalp, after the moistening pad and heating element have been placed in position. Patent 1683531. G. Decker, c/o The Realistic Permanent Waving Mfg. Co., Cleveland, Ohio.

CUE RACK OR THE LIKE—Primarily intended for supporting billiard cues but may be applied to gun racks, whip racks or other holding devices for supporting elongated articles in vertical position. Patent 1683533. T. Drost, c/o Wagner & Adler Co., 44 E. 14th St., New York, N. Y.

LAMP-SHADE FRAME—Of dual character, which will be useful optionally, in conjunction with either a drop lamp bulb or an upright lamp bulb. Patent 1683585. A. Lustig, c/o Idealistic Electric Lamp Shade Co., 34 E. 29th St., New York, N. Y.

VANITY CASE—Having a lid which is hingedly connected with a holding ring through a pentle structure integral with the ring, or independent thereof. Patent 1683551. W. G. Kendall, 118 Market St., Newark, N. J.

WINDOW CURTAIN FITTING—Which will prevent dust accumulating on shade rollers, and provide a supporting means for the shade, and dust portector, so that either may be readily removed. Patent 1683568. V. H. Moody and C. W. Kempton, 19 Fairview Ave., Gloucester, Ohio.

SOUND-ABSORBING SURFACE AND PROCESS OF PRODUCING SAME—Which includes porous granular particles, and a gypsum base, that will prevent close packing and produce voids, for use on ceilings, walls and the like. Patent

not only were caught but were consumed by slow combustion and that the steel wool would not become fouled over a long period of use. He obtained another patent.

Between those two patents, however, another man, Foll, had obtained a patent, disclosing steel wool with a layer of asbestos to filter the fumes from a gas oven. Foll's patent was a plain anticipation of Koehler's second patent. The Koehler patent came into the possession of Akme Flue, Inc. The Aluminate Flexible Flue Cap Company, relying upon the Foll patent, began making and selling a similar flue. The former company sued the latter for infringement of Koehler's second patent. The District Court for the Eastern District of New York denied an injunction, holding that the patent was invalid, being anticipated by the Foll patent. The Circuit Court of Appeals, however, reversed the decision, Judge Swan saying:

"Koehler must rely upon his proof of discovery before March 13, 1922, the date of Foll's application. His testimony is that as the result of experiments with steel wool and asbestos filter mats, he learned by May, 1921, that the steel wool alone consumed the greases and was superior to steel wool and asbestos in contact. He sold his first patent, which discloses an asbestos filter, to Tyson and Frame in June, 1921, and then advised them to use the steel wool mat. There is ample corroborative oral testimony as to his use of steel wool in flues made in the spring of 1921.

"We are satisfied that upon this record the patent in suit is not shown to have been anticipated and should be held valid. The substitution of a known material has frequently been held to constitute invention."

Figs and Nujol

WHEN the California Peach and Fig Growers Association of Fresno, California, sought to register the term "Nujol" as a trademark for dried figs, and the Standard Oil Company, of Bayonne, New Jersey, opposed the application as a violation of their prior use and registration of the term "Nujol" as a mineral oil, the Examiner of Interferences promptly dismissed the opposition.

Now at first glance, dried fruits and mineral oils have no more in common than have coffee and salad, over which the "Maxwell House" trademark controversy was waged. First Commissioner Kinnan thought differently, however. In overruling the Examiner, he held:

"It is apparent at once that the applicant has adopted the identical trademark alleged to have been adopted and used by the opposer continuously since a date long prior to the entrance of the applicant into the field, and the latter has used the mark upon one well-known kind of a laxative, while the opposer has used it upon another well-known kind. Both substances, the mineral oil and the figs, being used for the same purpose, this case is not so clear that the motion to dismiss should be granted.

"Furthermore, the allegation in the notice that the applicant uses the trademark upon figs treated with 'Nujol' brings the goods substantially within the class to which the opposer applies its mark. Mineral oil as a laxative and figs treated with mineral oil as a laxative constitute goods which would appear to possess the same descriptive properties."

1682986. L. B. Rymarczick, Los Angeles, Calif.

CREAM SEPARATOR—By means of which cream may be taken from milk in an ordinary milk bottle without touching the hands of the operator. Patent 1683882. J. A. Frisk, 3839 Roscoe St., Chicago, Ill.

INDICATOR OR PROMPTER FOR HOUSEHOLD OR OTHER PURPOSES—To be used as a reminder for the purchase of household articles, or other indicia, disclosing at a glance the matter to be called attention to. Patent 1684346. J. De-Bracht, c/o Juniata Crossing Hotel, Everett, Pa.

DISPLAY STAND—Formed of a standard and wire arms projecting laterally for supporting articles, the lower end of the arms having lugs for engaging the standard. Patent 1684340. R. O. Berke, c/o W. C. Nevin Candy Co., Box 566, Denver, Colo.

BATH-CURTAIN SUPPORT—For adjustably supporting a curtain over a bath tub, in position to surround the user, the device may be folded to occupy little space when not in use. Patent 1684284. H. Madison, 2017 So. 11th St., Council Bluffs, Iowa.

STAIR COVERING APPARATUS—Adapted to fit against the treads of the stairway and support independent floor covering sections, stairs can be easily covered or re-covered without skilled labor. Patent 1684328. C. M. Molinelli, 216 Beach 103 St., Rockaway Beach, L. I., N. Y.

MEASURING AND DISPENSING DEVICE—Adapted for use in connection with a receptacle containing sugar, or the like, permitting the user to dispense a teaspoonful, or any measure, as desired. Patent 1684313. R. V. Graham, Hill View and Aqueduct Ave., Yonkers, N. Y.

HOLDER—Comprising a pair of spring actuated clamping members and a pivotal connection, is quickly attachable and detachable, for adjustably holding flashlights, or other articles. Patent 1684347. A. S. Dobbs, 26 Redmond St., New Brunswick, N. J.

CONDIMENT SET—Inseparable, ornamental and insures positive results. For dispensing condiments, singly or simultaneously. Patent 1684623. Charles Hartwig, Hastings-on-Hudson, New York.

BUILDING CONSTRUCTION—A device by means of which suspension bars or rods for metal lath, or similar ceiling material, used in concrete ceilings, may be quickly applied. Patent 1684605. E. F. Tecemer, 2441 Sunnyside Ave., Chicago, Ill.

SPACER—Which may be formed from a single piece of wire of any desired length, for fastening together at right angles, reinforcing elements in concrete construction. Patent 1684051. F. W. Anderson, 413 Lynn St., Seattle, Wash.

MAGAZINE BUFFER—Of the reservoir type, designed to contain a substance to be applied and subsequently worked over a surface to polish or give a desired finish thereto. Patent 1685333. H. MacDougall and W. G. Kendall, 85 Oakland P.O., Maplewood, N. J.

DISPENSING APPLICATOR—For use in connection with hair tonics or the like, equipped with means for controlling the discharge and a series of massaging bits for applying the liquid. Patent 1685727. R. Stewart, 10914 108th St., Ozone Park, L. I., N. Y.

Hardware and Tools

ROTARY DRILL BIT—Which is self sharpening, the cutters being hardened on the surface, so that as the softer material wears away it leaves a cutting edge constantly sharp. Patent 1683502. H. R. Tunnell, 2745 Edward St., Butte, Mont.

WEATHERPROOF-CONCEALED HINGE AND JAMB CONSTRUCTION—For closures, such as casement windows and doors, which will be protected from the elements of weather, and exclude dust and dirt from the moving parts. Patent

1684823. J. Kubelka, 6217 Vincent St., Ridgewood, L. I., N. Y.

WEATHERPROOF HINGE—Enclosed in such a manner as to conceal and protect it from the effects of the elements and to prevent the elements passing the joint formed. Patent 1685002. V. J. Matraga, 852 Elizabeth Ave., Elizabeth, N. J.

JACK—Including a plurality of telescopically associated tubular sections, with means for introducing fluid under pressure for distending the jack, and means for collapsing the sections into nested relation. Patent 1685697. C. F. Guerin, c/o N. M. Guinsburg, 1 Liberty St., New York, N. Y.

CLAMPS—Which can be applied to or removed from the tubular sections of derrick legs, requiring relatively little time or labor in erecting or dismantling a derrick. Patent 1685696. G. Frank, Box 983, Wichita Falls, Texas.

Heating and Lighting

INTERCHANGEABLE SIGN ELEMENT—Including a bulb and interengageable means, whereby the type of plugs desired for flood lighting, or penetrating illumination is facilitated, the device particularly applicable to signs. Patent 1683570. L. N. Moss, Cedarhurst, L. I., N. Y.

GAS-HEATED STEAM RADIATOR—By means of which substantially all the heat is radiated upwardly and outwardly, without danger of overheating the floor, or wall behind the radiator. Patent 1684871. J. F. Firth, 1169 Washington Ave., Bronx, N. Y.

Machines and Mechanical Devices

PULLEY ATTACHMENT—For the carrying shaft of a grain thrasher, whereby the effective diameter will be increased, and the thrasher will be adapted for use as a pea or bean huller. Patent 1683562. C. Mackert, St. Anthony, Idaho.

FILLING MECHANISM—Which can be applied to a machine for filling a plurality of bottles, and has means for releasing any desired amount of air pressure from each bottle during the filling. Patent 1683677. J. Kantor, O. W. Fick and W. J. Traxel, c/o J. H. Pratt Liquid Carbonic Co., 3100 So. Kedzie Ave., Chicago, Ill.

WINDOW-OPERATING MECHANISM—By which sliding sashes can be manually operated to open and intermediate positions, and automatically locked either in closed or open position. Patent 1683914. F. J. Pfiffer, 1778 Evans Ave., Ventura, Calif.

GRAIN-BIN FEED—For application to a grain elevator of the usual type, to regulate the feed of grain from the dumping pit into the "leg" or upright casing. Patent 1684338. O. F. Aplin, Culbertson, Mont.

INSTRUMENT FOR SURVEYING BORE HOLES—By which the direction of the hole and its inclination with respect to the horizontal may be determined in a manner to enable the survey to be accurately computed. Patent 1684337. L. B. Wright, A. B. Yates and A. M. Lease, c/o Lawrence B. Wright, Lead, So. Dak.

ROAD-BUILDING MACHINE—Adapted to remove a predetermined depth of a road for producing a fine grading or planing of the roadbed preliminary to its treatment with a surface coating. Patent 1685687. H. F. Thompson, Stratford, N. Y.

MACHINE FOR PAPER-MAKING PROCESSES—Comprising a casing and a rotor which may be readily converted to be utilized as a knottter, silver screen, screen, pulp washer, thickener, filter, and save-all. Patent 1685736. H. D. Wells, 35½ Grant Ave., Glens Falls, N. Y.

BRICK ICE-CREAM CUTTER—Which is adjustable to cut ice cream into any desired number of sections, the support acting as a receiving member for the removal of the ice cream. Patent 1685700. C. A. Kulenkampf, 123 White St., New York, N. Y.

Prime Movers and Their Accessories

ENGINE EXHAUST—Which operates to effect a thorough and instant removal of the burned gases, in such manner as to make the exhaust less objectionable. Patent 1685006. G. W. Schultz, Mertztown, Pa.

MUFFLER—Adapted to break up the exhaust gases into fine streams, thus cooling and causing a uniform flow, and less noise when the gases are expelled. Patent 1685302. H. E. Tyler, 2818 N. Fairfield Ave., Chicago, Ill.

Pertaining to Recreation

AQUATIC AMUSEMENT DEVICE—Provided with buoyant elements for supporting an operator in the water, with means whereby he may propel and steer himself. Patent 1683058. H. Uberto, 2464 4th Ave., Astoria, L. I., N. Y.

GOLF BLINDERS—Through which a player may properly observe the ball and a limited area around it, when driving, but may have such vision as is desired after the drive. Patent 1683505. N. S. Walker, 71 Broadway, New York, N. Y.

SKI HANDLE—A substantially arc-shaped handle which will provide means whereby the same may be conveniently grasped by either a tall or short person. Patent 1684826. A. E. Martinson, 85 Poplar Ave., Silver Beach Garden, Bronx, N. Y.

Pertaining to Vehicles

TANK GAUGE—Adapted to be applied to a gasoline tank for accurately indicating at a distance from the tank the quantity of liquid therein at any given time. Patent 1683557. C. F. Kokemiller, R. No. 1, Box 361, Story City, Iowa.

METHOD OF DAMPING OSCILLATIONS FOR USE WITH SUSPENSION LEAF SPRINGS AND THE LIKE—Which consists in creating between the leaves an elastic friction of an intensity which may be regulated to oppose oscillations, and thus obtain a very smooth suspension. Patent 1683522. F. L. Broussouse, c/o Office Pickard, 97 Rue St. Lazare, Paris, France.

COMBINED LOCKING DEVICE AND SEAL—By which the usual couplings for connecting a speedometer head and a driving element can be securely locked and sealed against tampering. Patent 1683932. A. D. Summers, 332 Witmer St., Los Angeles, Calif.

TIRE-PRESSURE INDICATOR—Which will visibly indicate by different signals to the driver of a vehicle, while the car is in motion, whether the tires are properly inflated. Patent 1683343. J. H. Gartner, 150 Sequoia Drive, San Anselmo, Cal.

SAFETY BUMPER—In which the members which actually contact with a person struck are made of flexible material, quickly giving and thus reducing the shock. Patent 1683288. H. M. Bowman, 134 Bryant St., Mountain View, Calif.

DEVICE FOR INSPECTING TIRES—A supporting device for facilitating the handling of tires and outer casings, when it is desired to inspect the exterior or interior surfaces for punctures or imperfections. Patent 1685038. M. Telch, 103 North Division St., Peekskill, N. Y.

ATTACHMENT OF MOTOR-VEHICLE ROAD SPRINGS—Applicable to springs which are hingedly attached, the bearing surfaces being formed somewhat flattened in V-shaped cross section, whereby sidewise movement and rattle are prevented. Patent 1685005. D. Robertson, c/o Collision & Co., 488 Collins St. Melbourne, Australia.

HIGH-SPEED TRANSPORTATION SYSTEM—A vehicle having the advantages of an aeroplane and an electric car, operated safely upon elevated tracks, thus avoiding the anxiety caused by high flight. Patent 1685035. W. E. Robertson, 412 Washington St., Reading, Pa.

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Lack of space makes it impossible to give many cross-references or to enter a given reference in more than one place. Each article is therefore entered where it is believed it will be most easily found. In every case, the general subject should be sought rather than the supposed specific title of an article. We call special attention to the classifications "Aviation," "Household," "Medicine," "Radio," etc., under which many items will be found whose location otherwise would be very puzzling. The asterisk (*) indicates that the article in question is illustrated.

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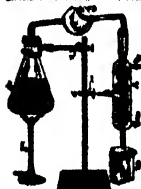
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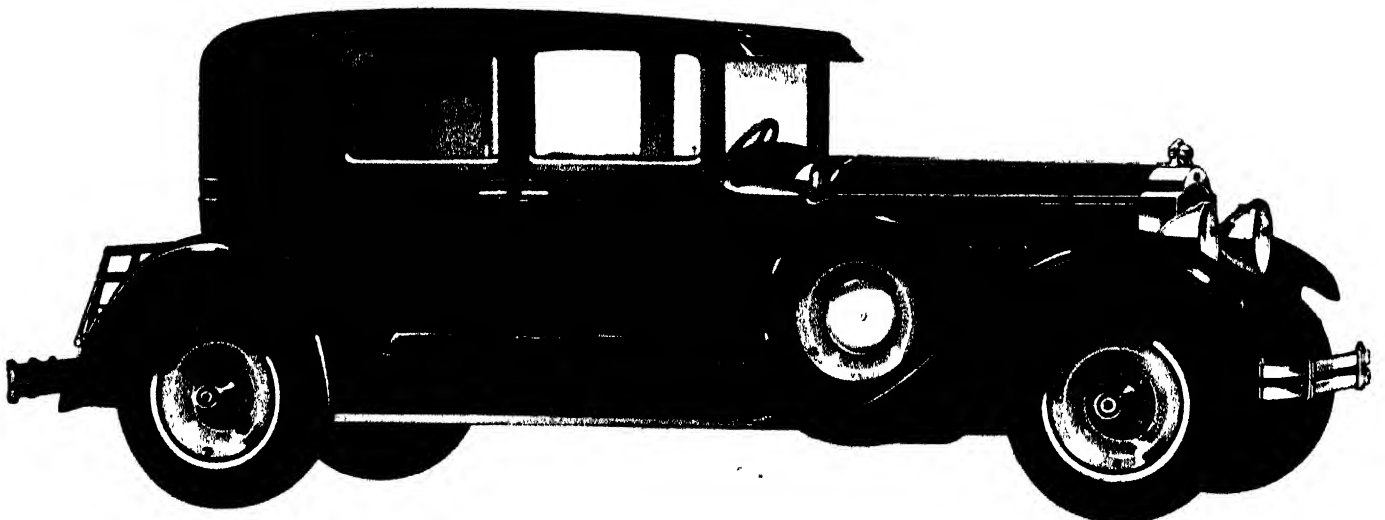
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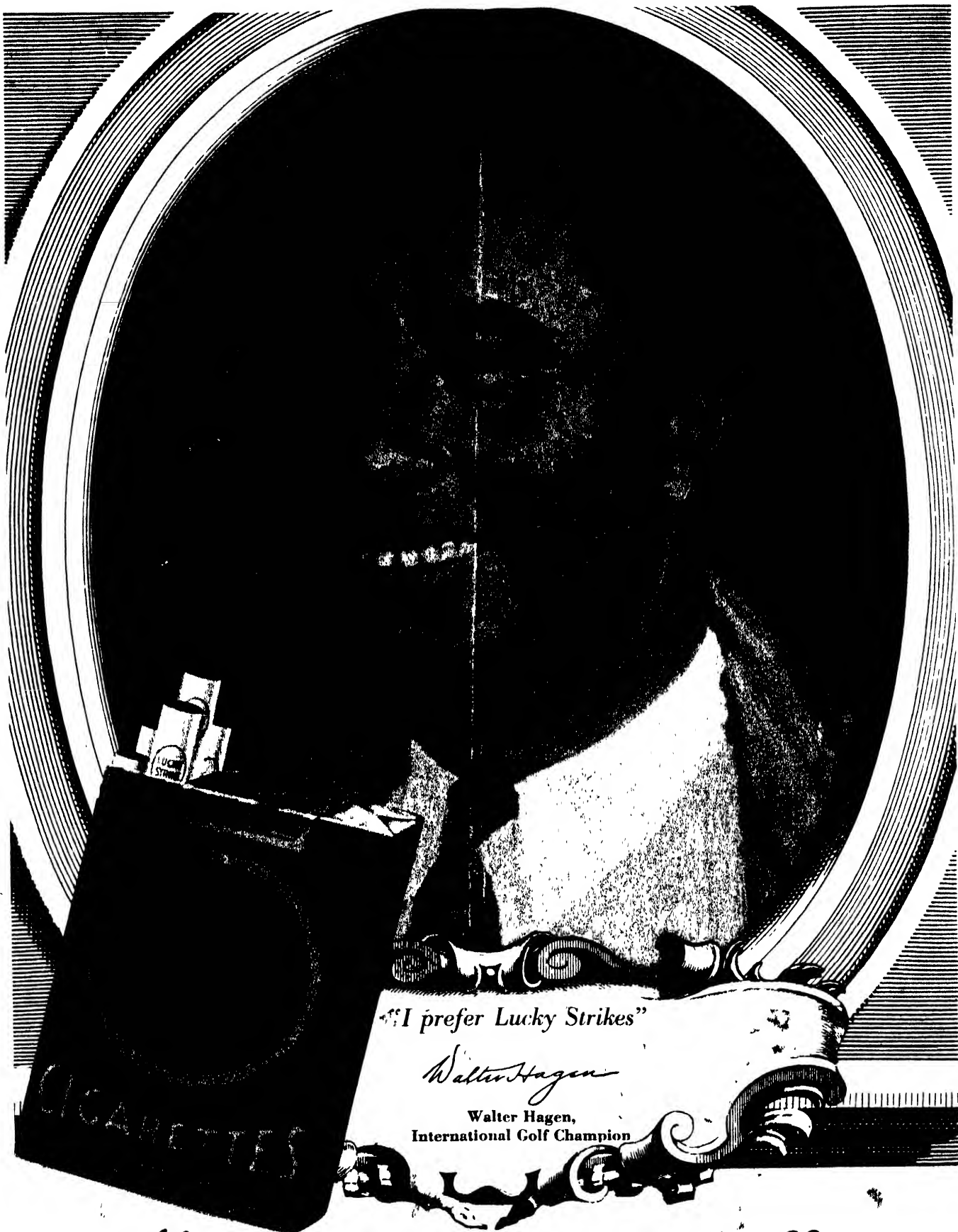
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